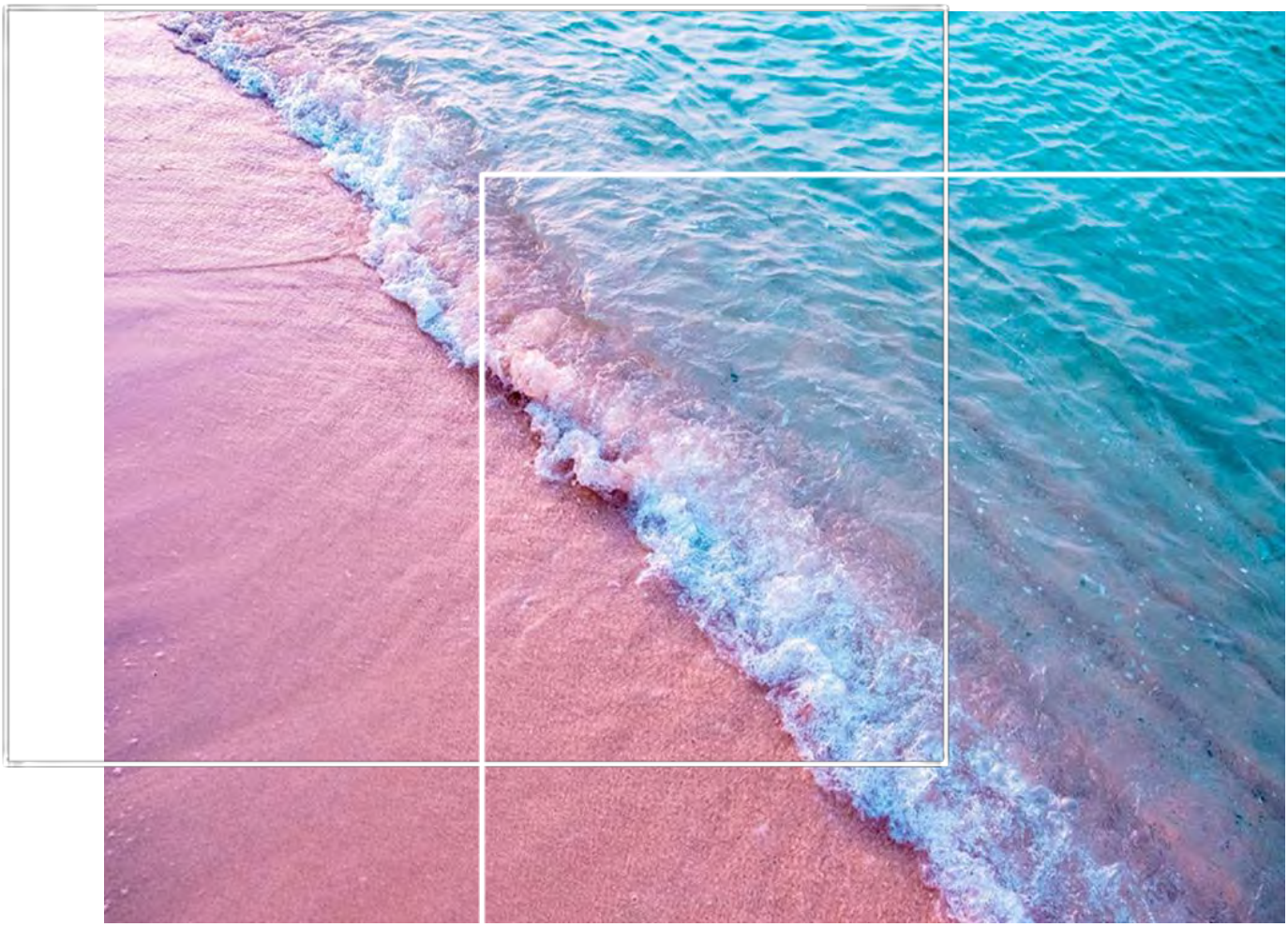

Namibian Marine Phosphate (Pty) Ltd

Submitted to: Namibia Marine Phosphate (Pty) Ltd.
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REPORT:

SANDPIPER MARINE PHOSPHATE PROJECT – ENVIRONMENTAL MANAGEMENT PLAN

PROJECT NUMBER: ECC-133-377-REP-21-D

REPORT VERSION: REV 02

DATE: OCTOBER 2022

TITLE AND APPROVAL PAGE

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Client Company Name:	Namibia Marine Phosphate (Pty) Ltd.
Client Representatives:	Mr C. Jordinson & Mr M. Woodborne
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DISCLAIMER

Environmental Compliance Consultancy (ECC) (Reg. No. CC 2013/11401) has prepared this environmental and social impact assessment and the EMP on behalf of the proponent. This report has been authored by employees of ECC, who have no material interest in the outcome of this report, nor do any of the ECC team have any interest that could be reasonably regarded as being capable of affecting their independence in the preparation of this report. ECC is independent from the proponent and has no vested or financial interest in the project, except for fair remuneration for professional fees rendered based upon agreed commercial rates. Payment of these fees is in no way contingent on the results of this report or the assessment, or a record of decision issued by Government. No member or employee of ECC is, or is intending to be, a director, officer, or any other direct employee of Namibia Marine Phosphate (NMP). No member or employee of ECC has, or has had, any shareholding in Namibia Marine Phosphate (NMP). Any personal views or opinions expressed by the writer may not necessarily reflect the views or opinions of Environmental Compliance Consultancy or its client.

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DEFINITIONS AND ABBREVIATIONS

ABBREVIATIONS	DESCRIPTION
%	percentage
µPa	micro pascal
AUV	autonomous underwater vehicles
AVS	Acid volatile sulphides
dB	decibel
CFCs	chlorofluorocarbons
cm	centimetre
CO_2	carbon dioxide
CSI	corporate social investment
CTD	water column characterization
e.g.	for example
etc.	et cetera
ECC	environmental clearance certificate
ECC	Environmental Compliance Consultancy
EMA	Environmental Management Act
EMP	environmental management plan
EMS	environmental management system
ERP	emergency response plan
ESIA	environmental and social impact assessment
EXCO	executive committee
GIS	geographic information system
GPS	global positioning system
H_2S	hydrogen sulphide
HR	human resources
Hz	hertz
I&APs	interested and affected parties
IMO	International Maritime Organization
ISM	International Safety Management
km	kilometre
km^2	Kilometre squared
L	litre
m	metre
m^3	metre cubed
mm	millimetre
MARPOL	International Convention for the Prevention of Pollution from Ships
MEFT	Ministry of Environment, Forestry and Tourism

MFMR	Ministry of Fisheries and Marine Resources
ML	mining licence
MME	Ministry of Mines and Energy
MSDS	material data safety sheet
MWT	Ministry of Works and Transport
NamPort	Namibia Ports Authority
NHC	National Heritage Council
NGOs	non-governmental organisations
nm	nautical mile
NMP	Namibian Marine Phosphate
No.	number
NOx	nitrogen oxides
OHSE	occupational, health, safety and environment
POC	Particulate organic carbon
PPE	personal protective equipment
ppm	parts per million
P&I	protection and indemnity
ROV	remotely operated vehicle
SPL	sound source level
SOPEP	shipboard oil pollution emergency plan
SOx	sulfur oxides
ToR	terms of reference
TSHD	trailing suction hopper dredger
TBT	tributyltin
TSHD	trailing suction hopper dredger
VOCs	volatile organic compounds
ZOI	zone of influence

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Environmental Compliance Consultancy (ECC) has been retained by Namibian Marine Phosphate (Pty) Ltd (NMP) ("The Proponent") to conduct an environmental and social impact assessment (ESIA) for the mining of phosphate, within the proposed mining area located in Mining Licence (ML) 170, off the Namibian coast 120 km to the southwest of Walvis Bay (-24° 19′ 59.99″ S: 13° 53′ 20″ E). The eastern boundary of the mining licence is located approximately 40 km off the coast (directly west of Conception Bay) (see Figure 1).

The proposed Sandpiper Marine Phosphate Project ("the Project") will undertake mining activities within an initial target area (SP01) which is within ML 170 representing approximately 2.2 % of the total mining licence area of 2,233 km^2. The proposed mining operation will entail dredging and recovery of marine phosphate sediments using a trailing suction hopper dredger (TSHD) from water depths between 190 m to 250 m. The scale of the proposed Project within SP1 target area will involve mining of a total area of 34 km^2 over a period of 20 years at an average of less than 1.7 km^2 annually, that equates to 0.0003 % of the seabed within Namibia's exclusive economic zone, coexisting with existing marine diamond mining and the fishing industry operations of a significantly larger scale. The other target sites SP02 and SP03 also contain phosphate resources and may be considered at a later stage (refer Figure 1).

ECC has compiled this environmental management plan (EMP) in terms of the Environmental Management Act (EMA), No.7 of 2007 and its regulations of 2012. The purpose of this EMP is to support the full environmental and social impact assessment (ESIA) report. The EMP has been updated since the submission of the draft environmental and social impact assessment report and environmental management plan.

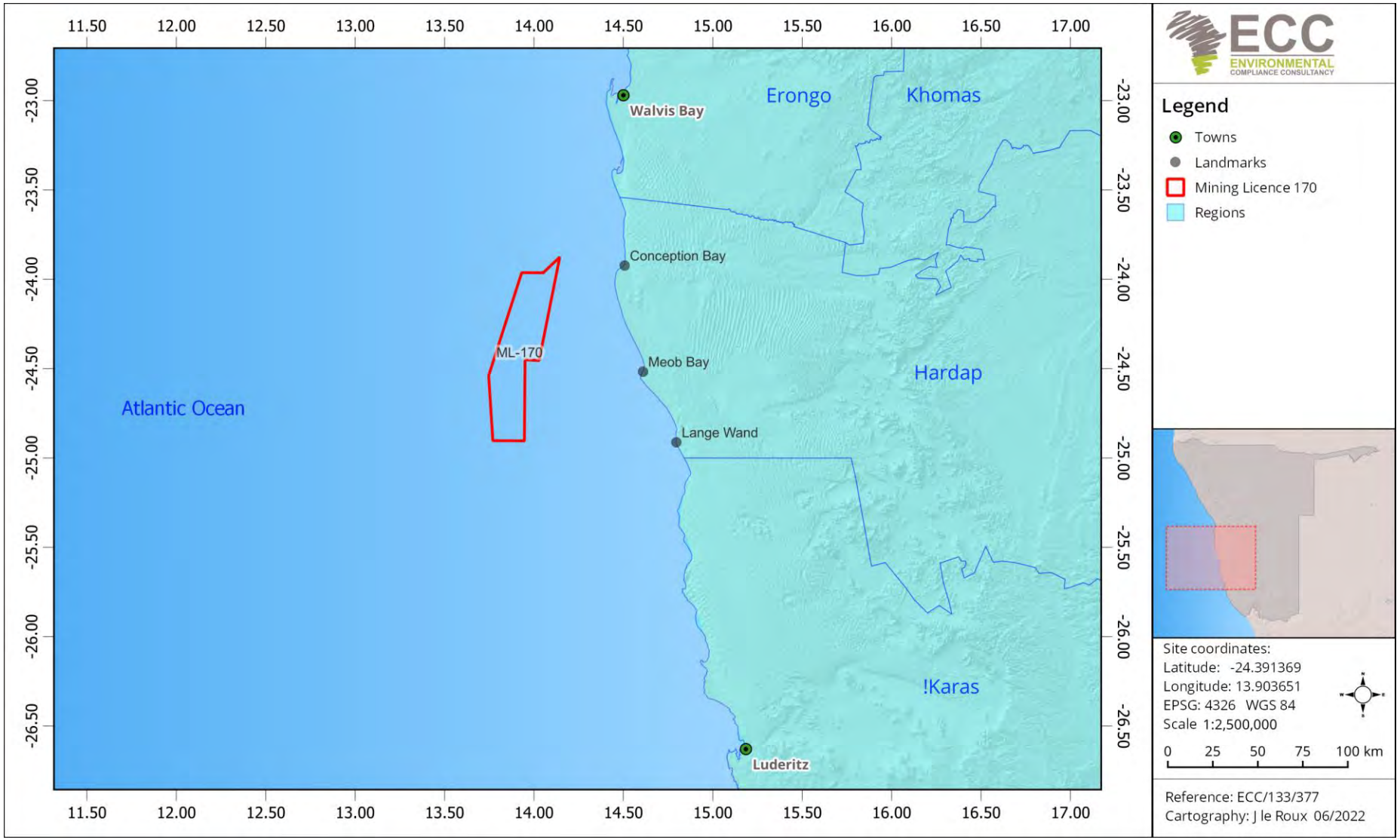

Figure 1: Locality map showing the location of the proposed Sandpiper Marine Phosphate Project

1.2 ENVIRONMENTAL REGULATORY REQUIREMENTS

The proposed Project is considered as a listed activity as stipulated in the Environmental Management Act, No. 7 of 2007 and its regulations, promulgated in 2012. An ESIA report and environmental management plan (EMP) are required to be submitted as part of the application to support the decision-making process for issuing an environmental clearance certificate.

This report presents the EMP and has been undertaken in terms of the requirements of the Environmental Management Act, No. 7 of 2007 and its regulations.

1.3 PURPOSE AND SCOPE OF THIS REPORT

The environmental management plan (hereafter referred to as the EMP) provides a logical framework, mitigation measures and management strategies for the mining activities associated with the proposed Project. This ensures that the potential environmental and social impacts are curbed and minimised as far as practically possible and that statutory and other legal obligations are adhered to and fulfilled. Outlined and defined in the EMP are the protocols, procedures and roles and responsibilities to ensure that management requirements are effectively and appropriately implemented.

The EMP forms an appendix (Appendix A) to the ESIA and is based on the findings of the assessments carried out to date. The environmental and social impact assessment provides for further information on the proposed Project, assessment methodology, terms of reference (ToR), applicable legislation and assessment findings.

This EMP is a live document and shall be reviewed at predetermined intervals and/or updated during the ESIA process when or if the scope of work alters, or when further data or information is added. All personnel working on the Project will be legally required to comply with the requirements set out in the final EMP that is approved by the competent authorities and Ministry of Environment, Forestry and Tourism (MEFT).

The scope of this EMP includes all activities associated with the marine component of mining related activities.

1.4 MANAGEMENT OF THIS EMP

The Proponent, NMP, will hold the environmental clearance certificate for the proposed Project and will be responsible for the implementation and management of this EMP. Before the mining activities commence in line with additional monitoring baseline requirements, this EMP will be reviewed, amended as required and approved ready for implementation. The implementation and management of this EMP and thus the monitoring of compliance, will be undertaken through daily duties and activities, as well as defined monthly and annual or other periodic inspections and/or monitoring surveys.

1.5 LIMITATIONS, UNCERTAINTIES AND ASSUMPTIONS RELATED TO THIS EMP

This EMP does not include measures for compliance with statutory occupational health and safety requirements. This will be provided in the safety management plan to be developed by the Proponent.

Where there is any conflict between the provisions of this EMP and any contractor's obligations under their respective contracts, including statutory requirements (such as licences, project approval conditions, permits, standards, guidelines and relevant laws), the contract should be amended, and statutory requirements are to take precedence.

The information contained in this EMP has been based on the Project description as provided in the ESIA report. If and where mining requirements are changed, this EMP may require updating and/or potential further assessment to be undertaken.

1.6 ENVIRONMENTAL ASSESSMENT PRACTITIONER

Environmental Compliance Consultancy (ECC) (Reg. No. CC 2013/11401) has prepared this EMP on behalf of the Proponent.

This report has been authored by employees of ECC, who have no material interest in the outcome of this report, nor do any of the ECC team have any interest that could be reasonably regarded as being capable of affecting their independence in the preparation of this report. ECC is independent from the proponent and has no vested or financial interest in the project, except for fair remuneration for professional fees rendered based upon agreed commercial rates. Payment of these fees is in no way contingent on the results of this report or the assessment, or a record of decision issued by Government. No member or employee of ECC is, or is intending to be, a director, officer, or any other direct employee of Namibian Marine Phosphate (NMP). No member or employee of ECC has, or has had, any shareholding in Namibian Marine Phosphate (NMP).

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2 ENVIRONMENTAL MANAGEMENT FRAMEWORK

This EMP provides measures, guidelines and procedures for managing and mitigating potential environmental impacts. The EMP also indicates monitoring and reporting guidelines and sets responsibilities for those carrying out management and mitigation measures.

2.1 OBJECTIVES AND TARGETS

Environmental objectives and targets have been developed so that mining activities can minimise potential impacts on the environment, as far as reasonably practicable.

Environmental objectives for the Project are as follows:

- Zero pollution incidents
- Minimal impact to marine ecosystem structure and functionality
- Protect marine ocean water quality
- Protect local marine flora and fauna, benthic macrofauna and epifauna
- Use natural resources effectively and efficiently.

2.2 ORGANISATIONAL STRUCTURE, ROLES AND RESPONSIBILITIES

The Proponent shall provide a project team to oversee and undertake the preparation and mining activities, which will be composed of the Proponent's personnel and contractors. A nominated role shall be identified to ensure the management and implementation of this EMP is carried out throughout the Project life. The Proponent shall be responsible for:

- Ensuring all members of the project team, including contractors, comply with the procedures set out in this EMP
- Ensuring that all persons are provided with sufficient training, supervision and instruction to fulfil this requirement
- Ensuring that any persons allocated specific environmental responsibilities are notified of their appointment and confirm that their responsibilities are clearly understood
- Contractors shall be responsible for ensuring and demonstrating that all personnel employed by them are compliant with this EMP and meet the responsibilities listed above.

Table 1 lists the roles and responsibilities allocated to different management levels in the company and specific personnel.

Table 1 – Roles and responsibilities

ROLE	RESPONSIBILITIES AND DUTIES
Proponent	– Responsible for the overall management and implementation of the EMP. – Ensure environmental policies are drafted/updated and communicated to all personnel throughout the company and contractors. – Responsible for providing the resources required to effectively run the mine and comply with the EMP. – Appoint all managers needed to ensure effective running of the mine.

ROLE	RESPONSIBILITIES AND DUTIES
	– Ensure systems for proper induction and training of personnel and contractors are in place.
Mining manager	– Manage all activities on the mine. – Monitor daily operations and ensure systems are in place for implementation of the EMP. – Maintain the community issues and concerns register and keep records of complaints. – Ensure corrective action are taken and communicated to complainants. – Maintain up to date records of employees who have completed training and induction.
Vessel Captain	– Ensure that all contract workers, sub-contractors and visitors to the site are aware of the requirements of this EMP, relevant to their roles and always adhere to this EMP. – Report any non-compliance or accidents. – Receive, recording and responding to complaints. – Ensure adequate resources are available for the implementation of the EMP. – Ensure safe and environmentally sound operations. – Responsible for the management, maintenance and revisions of this EMP.
OHSE appointed person/Environmental manager	– Maintain the mine's EMS. – Draft and update mine specific environmental procedures. – Ensure on-mine induction training is relevant and address issues from this EMP. – Do all environmental audits and inspections and report findings to relevant personnel. – Check the implementation of corrective action for incidents and complaints. – Ensure all environmental monitoring and reporting is done. – Conduct environmental monitoring, audits and inspections. – Compile draft environmental reports.
Employees	– Adhere to measures set out in the EMP. – Ensure they have undertaken a site induction. – Report any operations or conditions which deviate from the EMP, as well as any non-compliant issues or accidents to the OHSE appointed person/Environmental manager.

2.3 CONTRACTORS

Any contractors hired during the mining activities for the Project duration shall be compliant with this EMP and shall be responsible for the following:

- Undertaking activities in accordance with this EMP as well as relevant policies, procedures, management plans, statutory requirements and contract requirements
- Implementing appropriate environmental and safety management measures
- Reporting of environmental issues, including actual or potential environmental incidents and impacts, to the vessel Captain
- Ensuring appropriate corrective or remedial action is taken to address all environmental impacts and incidents reported by employees and subcontractors.

2.4 EMPLOYMENT

The Proponent and all contractors shall comply with the requirements of the Republic of Namibia Regulations for Labour, Health and Safety and any amendments to these regulations. The following shall be complied with:

- In liaison with local government and community authorities, the Proponent shall ensure that local people have access to information about job opportunities and are considered first for construction/maintenance contract employment positions
- The number of job opportunities shall be made known together with the associated skills and qualifications
- The maximum length of time the job is likely to last for shall be indicated
- The international crew working on the vessel shall ensure that they are always in possession of valid travel documentation
- The Proponent shall ensure that skills transfer is affected toward the local employee base for the duration of the Project
- Every effort shall be made to recruit from the group of unemployed workers living in the surrounding area.

2.5 REGISTER OF ENVIRONMENTAL ASPECTS AND IMPACTS

An environmental review of the proposed Project has been completed to identify all the commitments and agreements made. A list of environmental commitments and impacts has been produced, which details deliverables including measures identified for the prevention of pollution or damage to the environment during the mining phase.

Table 2 provides a list of environmental aspects and impacts, as well as associated mitigation (as derived from the previous ESIA's) and monitoring measures, and the roles responsible for compliance. Each monitoring plan and programme are further explained in detail in sections 7.4, 7.5, 8.4, 9.5, and 10.7 further in this document. They will be subject to regular review by the Environmental manager and updated when necessary.

The Mining manager and Occupational Health, Safety and Environmental manager (OHSE) will use this register to undertake regular inspections (see next section) to ensure the Project is compliant with this EMP.

Table 2 – A list of environmental aspects and impacts, as well as associated mitigation and monitoring requirements

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
Employee awareness	– Improved awareness	– All personnel (including contractors) are to be made aware of the contents of the company environmental policy/procedures.	– OHSE audits and inspections.	– Mining manager – OHSE appointed person /Environmental manager
		– Define the roles, responsibilities and authorities of employees responsible for implementing this EMP. – Address training needs of staff required to implement specialised aspects of the EMP. – Maintain records of plans, decisions, data collected, communications made and emergency responses, which document the implementation of the EMP. – Provide instructions and training to all staff about aspects of the EMP that relate to their work. – Present environmental awareness training courses. – Subcontracting companies are to have specific environmental compliance requirements written into their contracts.	– OHSE audits and inspections.	– OHSE appointed person /Environmental manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
	– Safety at sea	– Adhere to conventional maritime obligations regarding vessels in distress. – Workplace safety enforced by procedural requirements and onsite training.	– OHSE audits and inspections. – Management review. – Training matrix and register.	– OHSE appointed person /Environmental manager
Employee occupational health	– Disease and illness in the workplace	– Vessel mitigation programmes to be developed.	– OHSE audits and inspections. – Occupational health programme.	– OHSE appointed person
Policy	– Continual improvement and performance tracking	– Annually undertake performance assessments to verify that the requirements of the EMP have been met. – Where compliance has not been achieved, present details of non-compliance and corrective actions taken / to be taken. – Submit the environmental performance reports to MEFT and MME.	– OHSE audits and inspections.	– OHSE appointed person /Environmental manager
	– Improved awareness	– Assess all actions required through the EMP, identify any changes and or new environmental issues arising. – Communicate and consult with authorities and key I&APs informing them of proposed changes to the EMP.	– OHSE audits and inspections. – Monitoring database.	– OHSE appointed person /Environmental manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		– Ensure that the outcome of specialist studies and the results of monitoring programmes as initiated are incorporated into the company integrated environmental information database/management system.		
	– Resources	– Allocate an operational budget that is adequate to cover all requirements as detailed in the EMP	– Financial audits	– Proponent
	– Financial surety	– Maintain protection and indemnity (P&I) insurance cover (initially indicated at US$ 1 billion). – Review the cover amount annually. – Review the scope of the cover is appropriate to the operational activities.	– Financial audits	– Proponent
Interaction with all marine users	– Disputes and accidental collisions	– Intention of operations – exclusivity of use – Inform NamPort in advance of expected docking, crew change and maintenance activities.	– Business administration	– Proponent
		– In advance of commencement of an annual dredging campaign, notify the following authorities in writing (location, nature and extent of operations):	– Business administration	– Proponent

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		○ The Executive Director: MME; ○ The Executive Director: MFMR; ○ The Executive Director: MWT, Department of Maritime Affairs; ○ Walvis Bay radio of intended vessel activities. – Additionally, on termination of dredging campaign activities of more than one month's duration, inform Walvis Bay radio.		
		– Record observations of and interactions with other vessels.	– OHSE Audits and inspections.	– Vessel Captain
Safety of passage	– Interaction with other vessels	– Display international standard signals when dredging. – De-activate signals when not dredging. – Always maintain visual watch. – An exclusive dredging zone is declared over the active dredging block area. – Vessels may transit through the area covered by ML 170 with due consideration of the defined safe working exclusion zone defined for active dredging operations on site and for the internationally applied rules of the road at sea	– OHSE audits and inspections. – Vessel logbook	– Vessel Captain – Mining manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		and navigational warning lights / signals. – Vessels undertaking fisheries stock assessment and or related scientific surveys are to request permission to enter ML 170 and the declared active dredging exclusion zone. The company / organisation intending to undertake these surveys is required to notify the Proponent (NMP) 14 days in advance, so that appropriate arrangements can be made.		
Marine Mammals and seabirds	– Disturbance from noise/vibration	– Initiate the marine sightings programme (birds, mammals and jellyfish). – Record the numbers and species sighted during all activities associated with the dredging operation. – Avoid disturbances of whales whilst underway.	– OHSE audits and inspections. – Marine sightings database – Refer to Section 10.7 – Noise and Vibration Monitoring	– Vessel Captain – Mining manager – OHSE appointed person /Environmental manager
Jellyfish	– Possible blockages of sea water intakes	– As part of the marine sightings programme when large concentrations of jellyfish are observed, advise the chief engineer to maintain watch on seawater intakes to ensure that	– OHSE audits and inspections; and – Pre-start checklists on all machines – Refer to Section 7.5 – Marine Biodiversity Monitoring	– Mining manager – OHSE appointed person /Environmental manager – Chief engineer

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		surface aggregating jellyfish do not block them.		
Water column and sediments, marine communities and organisms	– Pollution of seawater	– In the event of offshore bunkering - obtain permission from the Department of Maritime Affairs before refuelling outside of harbour limits and within the Namibian Economic Exclusive Zone. – If required obtain specific exemption from the Namibian Directorate of Maritime Affairs before refuelling within 200 nautical miles off the coast. – Confirm the bunkering procedure of the delivery vessel. – Ensure that both delivery and receiving vessels are familiar with each party's procedures and operational requirements for transfer of bunkers. – Bunkering in areas under the jurisdiction of the Walvis Bay Port Authority is to be carried out according to the requirements as prescribed by NamPort.	– OHSE audits and inspections; and – Pre-start checklists on all machines. – Refer to Section 7 – Marine Biodiversity Management Programme	– Vessel Captain – OHSE appointed person /Environmental manager
		– Reduce the probabilities of accidental grounding - sinking – collision through enforcement of safe operational vessel systems.	– OHSE audits and inspections; and – Pre-start checklists on all machines.	– Vessel Captain – Mining manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		– Maintain all emergency procedures and insurances as legally required. – Ensure that emergency procedures are current and in accordance with established standards of practice – regular exercise / drills.	– OHSE audits and inspections; and – Pre-start checklists on all machines. – Refer to Section 5 – Incident Reporting	– Vessel Captain – Mining manager – OHSE appointed person /Environmental Manager
	– Decline in Water column and sediments, marine communities and organisms	– For the target mining area SP-01, in the 24–36-month period after the environmental clearance certificate licence has been awarded and prior to commencement of year 1 dredging activities in SP01, the following sample / data collection surveys and assessments should be undertaken in order to update the existing baseline information and provide a fresh set of baseline reference data to support the environmental monitoring program once operations commence: o representative macrofaunal assemblages; o shell debris for examination for the presence of goby eggs;	– OHSE audits and inspections – Refer to section 7 – Marine Biodiversity Management Programme	– OHSE appointed person /Environmental Manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		○ grain size, organics, dissolved nutrients and H_2S. (surficial and internal samples); ○ radionuclides; ○ Distribution of bacterial mats / thiobacteria; ○ Benthic large epifauna biodiversity survey ○ Marine mammal, seabird and other marine fauna observations during survey operations; ○ Integrate output information into adjustments of the planned (ecological) recovery surveys and ○ Retain data and interpretations on an environmental database system.		
	– Pollution of seawater	– In the event that an emergency occurs (grounding, sinking, collision and fire) follow procedures in: ○ Shipboard emergency response manual ○ Shipboard oil pollution emergency plan (SOPEP).	– OHSE Audits and inspections; and – Pre-start checklists on all machines. – Incident records management – Refer to Section 9 – Spill Management Plan	– Vessel Captain – Mining manager – OHSE appointed person /Environmental manager – Employees

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		○ Shipboard hazardous spill manual. – In the appropriate manner notify: ○ MWT (Department of Maritime Affairs), MEFT, MME, MFMR and Walvis Bay Harbour Master/Captain and as is required, coordinate with them on the activation of the national oil spill response plan. Advise other parties as may be relevant to minimize damage to their activities. – Provide the following information when reporting a spill: 1. The volume of oil spilled (so MWT can determine whether or not it is significant). 2. The type and circumstances of incident, ship type, port of registry, nearest agent representing the ship's company.		

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		3. Geographic location of the incident, distance offshore and extent of oil spill. 4. Prevailing weather conditions and sea state in affected area (wind direction and speed, weather and swell) 5. Persons and authorities already informed of the spill. 6. Estimates of the numbers of different species of mammals and seabirds in the vicinity and of the numbers of each species oiled (if observed). – If feasible, rescue and stabilise oiled seabirds. – If feasible, transfer oiled seabirds to MFMR Lüderitz for further rehabilitation. – No CFC based fire-fighting equipment to be used.		
	– Pollution of seawater	– Use low toxicity biodegradable detergents to clean up spills: o Avoid spilling toxic chemicals but if spillages do occur then clean up spilled chemicals	– OHSE audits and inspections; – Incident records management.	– Vessel Captain – Mining manager – OHSE appointed person

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		immediately and place absorbent material (rags) used for this purpose in sealed waste containers for safe disposal on shore. o Keep records of spillages and estimate amounts not retrieved by clean up actions.	– Refer to Section 9.5 – Spill Response Measures	/Environmental manager
	– Pollution of the environment due to improper management of waste (general and hazardous solids and effluents)	– The oil content of any discharge is required to be less than 15 parts per million (ppm) (MARPOL: Annex 1). – Galley wastes discharged overboard only after maceration through a 25 mm screen (MARPOL: Annex V). – Sewage processed in approved treatment plants (MARPOL: Annex IV). – Do not discharge any treated or untreated sewage from a vessel within 4 nautical miles (nm) of land but comminuted and disinfected sewage may be discharged beyond 4 nautical miles. – Only incinerated wastes may be discharged overboard and then only when the vessel is more	– OHSE audits and inspections; – Incident records management; – Waste management inspections, registers and records; – Monthly report records; – Safe disposal certificates. – Refer to Section 8.4 – Waste Disposal Monitoring	– Vessel Captain – Mining manager – OHSE appointed person /Environmental manager – Employees

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		than 25 nautical miles from shore. – With the exception of macerated galley and incinerated wastes, do not dump or throw solid waste of any kind into the sea. – Do not discharge any hydrocarbon products into the sea. – Maintain a register of all wastes discharged to sea. – Contain all oils, grease or hydraulic fluids spilled on the vessel for disposal at a recognised and registered land-based disposal site. – Do not dump or throw any solid waste of any kind into harbours. – Do not discharge any sewage into harbours. – Do not discharge any oily or waxy effluents into a harbour. – Do not discharge effluent or water from any tank contaminated with greater than 15 ppm of oil into a harbour. – Separate wastes into recyclable and "other" materials. – Incinerate combustible materials on board. Store the		

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		balance in leak-proof skips for safe transfer to a registered waste site on land or contain all in leak-proof containers onboard and dispose at a recognised disposal site on a regular basis. – Maintain a waste record book of all discharged/incinerated food and domestic and operational waste (excluding oil, sewage or noxious liquids listed in other annexes to MARPOL) – Record waste in the record book under the categories of: i) Plastics, ii) Floating dunnage, lining or packaging material, iii) Ground-down paper products, rags, glass, metal, bottles, crockery, etc., iv) Paper products, rags, glass, metal, bottles, crockery, etc., v) Food waste, vi) Incinerator ash. – As per the prescribed form, record estimated amounts (m^3) of each category whenever		

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		waste is discharged to sea, or to reception facility ashore or to other ships, or incinerated, or in accidental or other exceptional discharge. Also record date/time of discharge/ occurrence, position of ship, and nature of discharge (incineration/ port/ facility/ name of ship) or circumstances and reasons for accidental or other exceptional discharge. – The officer in charge is to sign each record on the date of incineration or discharge, and the captain of the ship is to sign each completed page of the waste record book. – Keep records (vessel logbooks) of quantities and types of all hazardous materials and oils taken onboard vessels and of their method of storage, use and disposal.		
	– Hazardous chemical spills	– Do not discharge any hydrocarbon products into the sea. – Maintain a register of all wastes discharged to sea.	– OHSE audits and inspections; – Incident records management;	– Vessel Captain – OHSE appointed person /Environmental manager – Employees

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		– Contain all oils, grease or hydraulic fluids spilled on the vessel for disposal at a recognised land-based disposal site. – Do not discharge any oily or waxy effluents into a harbour. – Keep records (vessel logbooks) of quantities and types of all hazardous materials and oils taken onboard vessels and of their method of storage, use and disposal.	– Waste management inspections, registers and records; – Monthly report records; – Safe disposal certificates. – Refer to Section 9 – Spill Management Plan	
	– Removal of seabed sediment	– To aid recovery of benthic faunal assemblages' recovery: o Leave a residual layer of sediment of at least 30cm of the original deposit thickness over the clay footwall overlying the clay footwall, to retain a layer of sediment to aid benthic recolonization. o Leave undisturbed/pristine areas ('slivers or lanes/corridors') of the sediment to aid benthic recolonization. o Conduct a benthic monitoring programme with	– OHSE audits and inspections. – Monitoring database. – Regular EMP monitoring surveys as per defined programs and reporting from commencement of operations – Refer to Section 7.5 – Marine Biodiversity Monitoring	– Vessel Captain – Mining manager – OHSE appointed person /Environmental manager – Employees

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		adequate reference sites to make before/after comparisons and recovery rate estimates robust. Results of predicted dredge plume fines sedimentation patterns in the hydrodynamic modelling study (HR Wallingford, 2020) are to be used in allocations of reference and impact sample sites. o Prior to dredging commencing collect a fresh set of benthic sampling data and assessments to update the existing baseline information. This should be conducted after the environmental clearance certificate licence has been awarded in the 24–36-month period prior to commencement of dredging. o Benthos sampling should focus on macrofauna including the larger mobile epifauna and small commercially non-targeted		

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		fish species Regular macrofauna monitoring surveys of all selected sites to be carried out over the life of the project and if necessary, beyond to determine the time of recovery once dredging has ceased.		
	– Dredger sediment discharge polluting sea water	– Discharge tailings at 15 m or lower below the sea surface to increase the dilution of the sediment plume in the water column. – To diminish turbidity effects in the upper water column, ensure that the environmental valve is employed where and when possible, in the dredging programme. – Update the current environmental baseline reference data set to provide fresh reference data for the defined environmental monitoring program. This should be conducted after the environmental clearance certificate licence has been awarded in the 24–36-month	– OHSE audits and inspections. – Monitoring database. Refer to Section 7.5 – Marine Biodiversity Monitoring	– Vessel Captain – Mining manager – OHSE appointed person /Environmental manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		period prior to commencement of dredging. – Specified sample monitoring station distributions in the EMP to be adjusted such that the HR Wallingford predicted sediment plume distributions zone of influence (ZOI) are accounted for, especially for the reference sites. These being areas that encompass the SP01 Mine area and extended 25 km north, 9 km east, 17 km south and 3 km west of its borders.		
	– Change in local near bottom hydrographical conditions	– Leave behind a residual sediment layer of at least 30 cm and slivers of undisturbed seabed. – Routine pre and post dredging surveys to monitor natural recovery and re-sedimentation processes	– OHSE audits and inspections. – Monitoring database. – Refer to Section 7.5 – Marine Biodiversity Monitoring	– Vessel Captain – Mining manager – OHSE appointed person /Environmental manager
	– Toxic sediment exposure of water column	– Prior to dredging commencing collect a fresh set of sediment samples to be collected by box core for toxicity tests to be repeated to update the existing baseline information. A large GOMEX box core is recommended. This should be	– OHSE audits and inspections. – Monitoring database. – Refer to Section 7.5 – Marine Biodiversity Monitoring	– Vessel Captain – Mining manager – OHSE appointed person /Environmental manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		conducted after the environmental clearance certificate licence has been awarded in the 24–36-month period prior to commencement of dredging.		
	– Sediment plumes generated by dredger	– Ensure that the environmental valve is employed where and when possible, in the dredging programme. – During operations record wind speed and direction in vessels log. – Conduct visual operations of the plumes. – Monitor portion of clay in the overspill. – The current benthic environmental baseline reference data set needs to be updated. This should be conducted to provide fresh reference data for the defined environmental monitoring program after the environmental clearance certificate licence has been awarded in the 24–36-month period prior to commencement of dredging.	– OHSE audits and inspections. – Monitoring database – Refer to Section 7.5 – Marine Biodiversity Monitoring	– Mining manager – Vessel Captain

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		– The benthic baseline and monitoring survey programme needs to take into consideration the ZOI in positioning the reference sites outside the ZOI.		
	– Increased concentrations of H_2S in water column	– Monitor the existence and abundance of sulphur oxidizing bacterial mats in the proposed dredging areas pre and post, ore recovery operations. – The current environmental baseline reference data set needs to be updated to provide fresh reference data for the defined environmental monitoring program. This should be conducted after the environmental clearance certificate licence has been awarded in the 24–36-month period prior to commencement of dredging. – As part of the updating of baseline reference data prior to commencement of dredging operations pore water free sulphide concentrations need to be confirmed of fresh sediment obtained by a large GOMEX box core. Pore water is to be	– OHSE audits and inspections. – Monitoring database. – Refer to Section 7.5 – Marine Biodiversity Monitoring	– Mining manager – OHSE appointed person /Environmental manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		extracted from replicate sub-cores without exposure to air or overlying water with a pore water extracting device and analysed spectrophotometrically within a short period after collection. – These surveys are best achieved by seafloor imagery by ROV/AUV or sled-mounted cameras along transects across disturbed (impact) and control areas as the reflectivity of stored sulphur microgranules gives the bacteria and the surface of the sediment a white appearance, which can be seen on video/photos. – Surveys at impact and reference sites to be done pre-dredging and then once operations commence, surveys should be done at sequential 3-year intervals until an apparent stable condition has been attained.		
	– Release of H_2S from muds delivered to the vessel hopper	– Essential that on-boards air quality is monitored during recovery and production	– OHSE Audits and inspections. – Monitoring database.	– OHSE Appointed Person /Environmental Manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		operations if operating in muddy areas.	– Refer to Section 7.5 – Marine Biodiversity Monitoring	
Marine communities	– Introduction of alien species by the vessel	– Ballast discharges are controlled through the ISM approved Shipboard Ballast Management Plan (IMO guidelines on ballast water management).	– OHSE audits and inspections; – Pre-start checklists on all machines; and – Vessel ballast water management plan – Refer to Section 7.5 – Marine Biodiversity Monitoring	– Vessel Captain – Mining manager – OHSE appointed person /Environmental manager
	– Vessel Fouling	– All vessels painted with TBT-free anti-fouling hull paint	– OHSE audits and inspections. – Refer to Section 7.5 – Marine Biodiversity Monitoring	– OHSE appointed person /Environmental manager
	– Underwater sound generation/Vessel Noise emissions	– Section 3.2 and 10.7 of the EMP describes monitoring procedures for sound. – The approach needs to be formalised such that noise attenuation at stand-off distances is measured by hydrophone deployments. Distances can be 500 m, 1 000 m, 2 500 m, 5 000 m and 10 000 m. During these measurements	– OHSE audit and inspections; – Noise surveys; and – Monitoring database. – Refer to Section 10.7 – Noise and Vibration Monitoring	– Vessel Captain – Mining manager – OHSE appointed person/Environmental manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		'source' levels at the operating dredger need to be measured simultaneously. The purpose is to confirm measured and modelled attenuation rates supplied by the dredging contractor. This can only be carried out once the dredger is actively operating onsite in ML 170.		
Marine Biodiversity	– Illegal hunting, fishing and plant collection leading to decrease in flora and fauna populations	– Personnel will not catch, remove, injure, kill or feed any wild animal or bird which occurs in the area without a permit. – Personnel will not destroy, remove, disturb any bird eggs or nests. – Personnel will not catch, injure, kill or feed any sea life without a permit other than for sampling and monitoring as outlined in the EMP. – Conduct environmental awareness to sensitize employees about the importance of marine life conservation and protection. – Disciplinary action will be taken against anyone found contravening these rules.	– OHSE audit and inspections; – Monitoring Database – Refer to Section 7.5 – Marine Biodiversity Monitoring	– Vessel Captain – OHSE appointed person/ Environmental Manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
Air quality	– Air pollution – CO_2 emissions from planned operations	– NOx, SOx and VOCs are to be compliant with the requirements of MARPOL: Annex VI. – Only MARPOL approved incinerators may be used, and incineration may only take place according to MARPOL: Annex VI. – Use environmentally friendly substitutes for CFCs where feasible. – Phase out all use of ozone-depleting substances and equipment (refrigerators, engines etc.) with alternatives as per the Montreal Protocol on Ozone Depleting Substance as well as United Nations (UN) Framework convention on Climate Change 1997. – Ensure the regular maintenance of machinery and equipment to reduce the utilization of fuels and other petrochemical materials to reduce the release of greenhouse gases.	– OHSE audits and inspections; – Pre-start checklists on all machines; and – Monitoring programme – Refer to Section 0 – Air Quality Monitoring	– Vessel Captain – Mining manager – OHSE appointed person /Environmental manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		– The annual CO_2 emissions from the proposed dredging and sailing operations for the marine phase of the Sandpiper Project estimated should be included with the emission calculations for the land-based elements of the Sandpiper Project which includes the materials handling and processing operations. This will provide the total of NMP emissions that may need to be offset for the entire value chain of the mining and beneficiation steps as these are developed and instituted.		
Hazardous substances management	– Pollution of the environment due to a navigation hazard such as vessel collision or loss of equipment on ocean – Oil spill	– Establish hazards database, detailing: item, location, date, and recovery date. – Depending on the size of the loss, advise MWT (Department of Maritime Affairs) if it may present a navigation hazard.	– Hazard database; – OHSE audits and inspections; – Incident records management. – Refer to Section 8 – Waste management Programme	– Vessel Captain – OHSE appointed person /Environmental manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
Socio-economic	– Creation of jobs during project development	– Ensure that residents get first opportunity to apply for positions where applicable. – Give preference to companies with labour intensive focus and previously disadvantaged and marginalized groups.	– HR recruitment policies and procedures	– HR manager
	– Creation of jobs during operational mining	– Ensure that residents get first opportunity to apply for positions where applicable. – Give preference to companies with labour intensive focus and previously disadvantaged and marginalized groups.	– HR recruitment policies and procedures	– HR manager
	– Influx of contractors (workers and families) stimulating the local economy through increased spending	– Engage with the local and regional government to ensure development plans cater for influx; and – Ensure local spend of CSI funding addresses development needs to cater for influx where applicable.	– Annual review of CSI policies and procedures implementation	– Proponent EXCO – CSI manager
	– Contribution to the Namibian economy	– Include local small and medium enterprises when tendering for supplies and services. – Outsource where possible to Namibian companies. – Give preference to companies with labour intensive focus and	– HR recruitment policies and procedures – Procurement policies and procedures – Financial audits	– HR Manager – Procurement manager – Financial manager – Proponent EXCO

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		previously disadvantaged and marginalized groups. – Pay all applicable taxes and royalties.		
	– Fishing sectors commercially fishing in SP1	– Annual dredging campaigns will occupy a very small (1 %) area of ML 170 and SP1 area. The average annual mining area is 1.7 km^2. The dredge vessel will only be onsite in SP1 mining area for duration of approximately 16 hrs at a time and 3 times a week on average. The safety exclusion zone will apply only to the current mining area where the dredge vessel is operational. Accordingly fishing operations in the remainder of ML 170 will not be affected.	– Records of communications with fishing vessels – Vessel logbook	– Vessel Captain – Mining manager – Planners
National skill and educational development	– Improved environmental awareness and knowledge and capacity development	– Use monitoring and survey programmes as an opportunity for research opportunities for university students – Corporate Social Responsibility programme of the company to include consideration for inclusion of the following: – Provide bursaries and scholarships. – Sponsor Namibian research	– Social corporate responsibility goals – OHSE audits and inspections	– Proponent EXCO – OHSE Appointed Person /Environmental Manager

RECEPTORS	POTENTIAL IMPACTS	MANAGEMENT/MITIGATION MEASURES	MONITORING REQUIREMENTS	RESPONSIBILITY
		– Provide social contributions to the Erongo region		
Archaeological and historical sites and artifacts (chance finds)	– Loss of heritage information	– Stop dredging. – Advise the vessel captain. – Reinitiate dredging beyond a perimeter of 500 m from the suspected (identified) wreck location and / or as advised by the mining manager. – The mining manager is to advise the National Heritage Council as to the discovery. – Discontinue operations within the defined perimeter area and recommence only under the instruction of the National Heritage Council. – Retain all correspondence.	– Chance finds procedure and records. – Refer to Section 11 - Archaeological and Heritage Programme	– Vessel Captain – Mining manager

3 ENVIRONMENTAL MANAGEMENT PRINCIPLES

3.1 CONTINUAL IMPROVEMENT

The Proponent's management team is responsible for reviewing and updating this EMP, which will be supported by the regular reports from the dredging contractor. As part of this review process, the regular reports will be reviewed, identifying any trends or significant areas of concern, as well as measures implemented to manage / resolve environmental or social issues. Compliance and legislative changes will be reviewed, and lessons learnt will be captured. The EMP will be amended as required and follow up training, awareness or updates will be provided.

Ongoing hazard identification through the review of the EMP and supporting management plans and SOPs will ensure environmental impacts are avoided or minimised to as low as reasonably practicable as part of the continuous improvement of the EMS.

3.2 BEST PRACTICE

The best practice management measures that will be complied with in accordance with the MARPOL convention, during mining activities, are listed in summary in Table 3.

Table 3 – A list of environmental best practice measures to be implemented

ENVIRONMENTAL ASPECT	BEST PRACTICE REQUIREMENT
Pollution prevention control	– Vessel and equipment to be maintained and serviced regularly; – Refuelling at designated or approved locations; – Spill kits available wherever the risk of loss of containment is identified; – Bunds to be at least 110 % of the container; and – Good housekeeping.
Solid waste management	– Good housekeeping (no littering); – Designated waste collection areas on vessel and one central location; – Bins labelled; – Waste to be separated and kept clean and tidy; and – Waste bins emptied on regular basis.
Storage of fuels, oils, chemicals and other hazardous liquids	– Storage tanks will be suitable and labelled for the liquid being stored; – Bunds to be at least 110 % of the container; and – Daily inspections of tanks.
Energy efficiency	– Vessel and equipment to be maintained and serviced regularly; and turn off plant and equipment when not in use.
Air quality	– Turn off plant and equipment when not in use; and vessel and equipment to be maintained and serviced regularly.

ENVIRONMENTAL ASPECT	BEST PRACTICE REQUIREMENT
	– NOx, SOx and VOCs are to be compliant with the requirements of MARPOL: Annex VI. – Only MARPOL approved incinerators may be used, and incineration may only take place according to MARPOL: Annex VI. – Use environmentally friendly substitutes for CFCs where feasible. – Phase out all use of ozone-depleting substances and equipment (refrigerators, engines etc.) with alternatives as per the Montreal Protocol on Ozone Depleting Substance as well as United Nations (UN) Framework convention on Climate Change 1997.
Noise and Vibration	– Noise assessment water column characterisation (CTD). – Avoid disturbances of whales whilst underway .

3.3 ENVIRONMENTAL MONITORING

A monitoring and evaluation program will be used in line with internal OHSE standards to evaluate environmental performance and promote continual improvement. Monitoring also supports environmental management on-site to evaluate how effective the environmental management has been, over an extended period of time.

An environmental monitoring schedule will be put in place for the dredging vessel operations based on the recommendations of relevant experts and results of the specialist environmental studies completed as part of this assessment process.

The monitoring program will comprise inter alia:

- Noise and vibration monitoring (e.g., effect on mammals)
- Water quality monitoring (e.g., seawater quality, sediment plume dispersion)
- Benthic and biodiversity monitoring (e.g., benthic macrofauna, epifauna, marine flora and fauna)
- Air quality monitoring (e.g., onboard air quality)
- Carbon footprint monitoring.

The environmental manager will be tasked with conducting the monitoring with the support of the Chief Operations Officer, Mining manager and relevant staff of the dredging contractor (Vessel Captain, contractor OHSE and operations staff)

4 COMMUNICATION AND TRAINING

To ensure potential aspects and impacts are minimised it is vital that personnel are appropriately informed and trained on how to properly implement the EMP. It is also important that regular communications are maintained with stakeholders (if applicable) and made aware of potential impacts and how to minimise or avoid them. This section sets out the framework for communication and training in relation to the EMP.

4.1 COMMUNICATIONS

During dredging operations, the Environmental manager or OHSE manager(s) (NMP and dredging contractor vessel captains) shall communicate site-wide environmental issues to employees and contractors through the following means (as and when required):

- Ensure all personal are afforded the opportunity to attend an environmental site induction that sets out their requirements in relation to this EMP
- Ensuring audits and inspections are undertaken regularly on a risk-based schedule
- Toolbox talks, including instruction on incident response procedures
- Deliver specific environmental briefings where required
- Ensure all personnel have access to the EMP
- Ensure operators of key activities and environmentally sensitive operations are briefed and understand their requirements.

This EMP shall be distributed to the mining/dredging team including all contractors and personnel working in the mining licence to ensure that the environmental requirements are adequately communicated throughout all operational levels. Key activities and environmentally sensitive operations shall be briefed to workers and contractors.

During the mining/dredging activities, communications between the NMP and contractor management teams shall include discussing any complaints received and actions to resolve them; any inspections, audits, or non-conformance with this EMP; and any objectives or target achievements.

4.2 ENVIRONMENTAL EMERGENCY AND RESPONSE

An emergency is any abnormal event, which demands immediate attention. It is any unplanned event, which results in the temporary loss of management control at site but where functional resources can manage the response. An emergency response plan (ERP) will be put in place that defines and manages the roles, responsibilities, and actions to be taken in response to any emergencies including environmental emergencies that may occur onsite. The international dredging company, Jan De Nul, (JDN) which is the preferred contractor for the Project, operates dredging vessels internationally and have established emergency response plans for each vessel. The Project ERP will be integrated with JDN's existing ERP to incorporate local emergency services and contacts as shown in Table 4.

Table 4 – Emergency Contact details

TOWN	AMBULANCE	POLICE	FIRE BRIGADE	NAMPORT
Walvis Bay	+264 (0) 64-216-309/ Toll Free 924	+264 (0) 64-219-048	+264 (0) 64-201-3301/+246 (0) 81-122-4653	+264 (0) 64 208 2111

For large-scale spills and other significant environmental incidents, the fire services should be contacted as required and the Offices of the Ministry of Environment, Forestry and Tourism (MEFT) informed of the incident (telephone +264 61 284 2111) and the Ministry of Fisheries and Marine Resources (MFMR) (telephone +264 61 2053911). All correspondence with MEFT/MFMR should be undertaken by the Vessel captain with support from the OHSE/Environmental manager, Vessel Captain and a member from the NMP management staff. If a spill occurs within the port boundaries, NamPort OHSE Department will need to be informed.

For the clean-up of smaller spills, the relevant material safety data sheet (MSDS) should be consulted to determine the appropriate clean-up procedure. Basic spill response training will be provided as part of the site environmental induction, spill response equipment, including relevant MSDS copies, will be provided in areas where potentially environmentally hazardous chemicals may be used.

4.3 COMPLAINTS HANDLING AND RECORDING

Any complaints received verbally by any personnel related to the Project shall be recorded by the receiver including:

- The name of the complainant
- The contact details of the complainant
- Date and time of the complaint
- The nature of the complaint.

The information shall be given to the Vessel Captain who is overall responsible for the management of complaints on site. The Vessel Captain shall do the following:

- Inform of reported issues, concerns, or complaints.
- The Vessel Captain must maintain a complaint register that require details of the complaint, investigations and actions to be taken to rectify or address the matter, or where no action is taken and the reasons why.
- The Vessel Captain will provide a written response to the complainant produced with support from OHSE/Environmental and HR managers as required and including the results of any investigations and actions to be taken to rectify or address the matter(s) raised. Where no action is taken, the reasons why are to be recorded in the register.

The workforce shall be informed about the complaints register, its location and the person responsible for receiving and responding to formal complaints. The complaints register shall

be kept for the duration of the Project and will be available for government or public review upon request.

4.4 TRAINING AND AWARENESS

All personnel working on the Project shall be informed and educated when performing tasks that have the potential to cause an environmental impact. Awareness with be raised through appropriate education and training programmes. Site specific OHSE training and toolbox talks will be undertaken with all employees and contractors working onboard the vessel.

4.5 SITE INDUCTION

All personnel involved in the Project shall be inducted to the site with a specific environmental awareness training and health and safety issues. The environmental awareness training shall ensure that personnel are familiar with the principles of this EMP, and the environmental impacts associated with their activities, the procedures in place to control these impacts and the consequences of departure from these procedures. The vessel captain shall ensure a register of completed inductions and site-specific environmental awareness training (if required) is maintained. The site induction should include, but is not limited to a general site-specific induction that outlines:

- What is meant by “environment” and the EMP?
- Why the environment needs to be protected and conserved?
- How can mining activities impact the environment?
- What can be done to mitigate against impacts?
- The inductee's role and responsibilities concerning implementing the EMP
- The site’s environmental rules
- Details of how to deal with, and who to contact should any environmental problems occur
- The potential consequences of non-compliance with this EMP and relevant statutory requirements
- The role of responsible people for the Project.

5 INCIDENT REPORTING

The Proponent and appointed contractors must have an accident and incident reporting system. The section below sets out the minimum requirements for incident reporting and should be used as a basis for incident reporting.

5.1 MINOR INCIDENT OR "NEAR MISS"

Any incident or "near miss" involving the Proponent, a nominated representative, any contractor, or its subcontractors or any third party's personnel, property, plant or equipment must be:

1) Orally reported to the supervisor or the supervisor's nominated representative:
   a. Immediately and without delay.
   b. Regardless of whether or not injury to personnel has occurred.
   c. Property or equipment has been damaged.
2) Written up and handed to the supervisor or the supervisors nominated representative by the end of the shift. The written report should:
   a. State all known facts and conditions at the time of the incident and
   b. includes a preliminary assessment of the most likely potential consequences of the incident under the current circumstances.

5.2 SERIOUS INCIDENTS

For any serious incident involving a fatality, or permanent disability, the incident scene must be left untouched until witnessed by a representative of the Namibian police. This requirement does not preclude immediate first aid being administered and the location being made safe.

5.3 INCIDENT REPORT AND CLOSE OUT

The assigned supervisor or manager must investigate the cause of all work accidents and significant incidents and must provide the results of the investigation and recommendations on how to prevent a recurrence of such incidents. A formal root-cause investigation process should be followed.

6 COMPLIANCE AND ENFORCEMENT

6.1 ENVIRONMENTAL INSPECTIONS AND COMPLIANCE MONITORING

Inspections and audits of the site will be managed and undertaken by the Environmental manager to check that the standards and procedures set out in this EMP are being complied with and pollution control measures are in place and working correctly. All equipment will be inspected to ensure they are operating as per specification; no damage has been caused and no leaks or spills have occurred. Any non-conformance shall be recorded, including the following details: a brief description of non-conformance; the reason for the non-conformance; the responsible party; the result (consequence); and the corrective action is taken and any necessary follow up measures required. The application documentation for renewal of the environmental clearance certificate (ECC) must include a summary environmental audit report and copies of the six bi-annual reports that will be submitted every six months for the three years that the clearance certificate is valid for.

6.2 REPORTING

Statutory reports shall be submitted to the Mining Commissioner in terms of the Minerals (Mining and Prospecting) Act, No. 33 of 1992 and related conditions of ML 170.

Bi-annual environmental reports shall be submitted to the Environmental Commissioner every six months of every year during the ECC validity period. These reports should include records of the monitoring and other deliverables of every aspect or programme described in the EMP. Reports should be submitted within three months of the bi-annual period lapsing.

6.3 NON-COMPLIANCE

Where it has been identified that works are not compliant with this EMP, the Mining manager and/or Vessel Captain shall employ corrective actions so that the works return to being compliant as soon as possible. In instances where the requirements of the EMP are not upheld, a non-conformance and corrective action notice shall be produced. The notice shall be generated during the inspections and the vessel manager shall be responsible for ensuring a corrective action plan is established and implemented to address the identified shortcomings.

A non-compliance event / situation is considered if, for example:

- There is evidence of a contravention of this EMP and associated indicators or objectives
- The vessel captain and or contractor have failed to comply with corrective or other instructions issued by the environmental manager or qualified authority
- The vessel captain and or contractor failed to respond to complaints from the public.

Activities shall be stopped in the event of a non-compliance until corrective action(s) has been completed.

6.4 DISCIPLINARY ACTION

This EMP is a legally binding document and any wilful non-compliance with it may result in action being taken against the perpetrator(s) within the provisions of company policy, terms of commercial contracts and/or relevant laws in Namibia. Such action may take the form of (but is not limited to):

- Fines / penalties
- Legal action
- penalties imposed by the Proponent on the contractor
- Suspension or withdrawal of authorisations
- Suspension of work
- Non-renewal of environmental clearance certificate.

The appropriate action shall be determined according to the nature and extent of the transgression / non-compliance and penalties are to be weighed against the severity of the incident.

7 MARINE BIODIVERSITY MANAGEMENT PROGRAMME

7.1 INTRODUCTION

Dredging operations will include the recovery of sediments, discharge of fine tailings, sediment plume dispersion and related impacts on sea water quality and marine fauna, excluding general vessel activities. It is vital to ensure that all management, monitoring and mitigation actions are adhered to in order to manage and minimise environmental impacts and any potential pollution.

7.2 OBJECTIVES

The EMP objectives are to minimize negative direct effects of the operation on the marine environment. These objectives are:

- Mitigation and monitoring
- Avoid compromising future exploration of renewable marine resources by managing dredging-related impacts and mitigating or minimising these impacts
- Establish and maintain an information base that will assist in evaluating the cumulative impacts of their operations and establish recovery rates of marine habitats impacted during the dredging
- Minimise potential conflict with other marine users
- Promote information exchange with scientific institutions and I&APs
- Ensure safety of the operation, by applying all relevant safe vessel operations.

7.3 RESPONSIBILITIES

WORKFORCE AND ALL CONTRACTORS

Ensure safe operation protocols of the dredging vessel are enforced. They should optimally manage (reduce and recycle) all wastes generated and discharges to sea, air and land. They should maintain open communication with other marine users and minimise disruption to all other users of the sea by respecting the right of passage. They should always report any issues to the OHSE manager or Environmental manager.

ENVIRONMENTAL MANAGER

Will ensure that the objectives listed above are being met and provide performance feedback to the Vessel Captain, Chief Operations Officer and Mining manager.

7.4 MARINE BIODIVERSITY MANAGEMENT MEASURES

The marine biodiversity management plan measures are designed to mitigate and minimise the negative impacts of dredging on the seabed, ocean and marine flora and fauna as shown in Table 5. Dredging activities that could potentially alter the natural seawater quality, air quality and marine biodiversity include:

- Chemical spills
- Refuelling/Bunkering
- Dredger sediment discharge
- Removal of seabed sediment
- Operational noise and light.

Table 5 – Dredging Mitigation Measures

Responsibility	– Mining manager – Vessel Captain – OHSE appointed person /Environmental manager – Employees – Contractors
Potential issues or impacts	– Removal of seabed surficial sediments, destruction of benthos and benthic habitat. – Disturbance to fish and fauna on the seabed and in the water column. – Burial of benthic organisms. – Biogeochemical impacts on water quality and benthic organisms. – Release of heavy metals. – Release of dissolved nutrients. – Suspended sediment plumes.
Protection of benthos and seafloor in ML170	– Mining/dredging operations restricted to the defined 34 km^2 area for the 20-year mine plan which represents less than 2 % of the total ML 170 area of 2,233 km^2. – Annual mining/dredging operations cover an average of 1.7 km^2 per year which represents 5 % of the 20-year mine plan area (34 km^2) and 0.08 % of ML 170 (2,233 km^2) and 0.0003 % of the seabed within Namibia's exclusive economic zone. – For the target mining areaSP1, in the 24–36-month period after the environmental clearance certificate licence has been awarded and prior to commencement of year 1 dredging activities in SP1, the following sample / data collection surveys and assessments should be undertaken in order to update the existing baseline information and provide a fresh set of baseline reference data to support the environmental monitoring program once operations commence: o representative macrofaunal assemblages; o shell debris for examination for the presence of goby eggs; o grain size, organics, dissolved nutrients and H_2S. (surficial and internal samples); o radionuclides; o Distribution of bacterial mats / thiobacteria; o ;Benthic large epifauna biodiversity survey

	○ Marine mammal, seabird and other marine fauna observations during survey operations; ○ Integrate output information into adjustments of the planned (ecological) recovery surveys; ○ Retain data and interpretations on an environmental database system. – The same data would be required in due course prior to any approved dredging in the additional target mining areas SP02 & SP03. – For each annual target mining area in SP01, conduct geophysical surveys prior to dredging and post dredging, to determine / provide information on: ○ Area and volume (thickness) of sediment removed versus predicted; ○ Residual volume (thickness) of sediment covering the footwall; ○ Morphological character of the seafloor; ○ Habitat assessment; ○ Identify seabed areas within the dredged target area that are undisturbed by the dredging process; ○ Readjust frequency and scope of further post dredging geophysical surveys; ○ Integrate output information into adjustments for the next period of dredging; and ○ Retain data and interpretations on an environmental information database system. – Using geophysical survey techniques record the morphological characteristics of a completed dredge zone: ○ Integrate output information into subsequent ecological recovery surveys; and ○ Retain data and interpretations on an environmental data base system.
Protection of benthos and seafloor for SP1	– To aid recovery of benthic faunal assemblages' recovery: ○ Leave a residual 30 cm layer of sediment overlying the clay footwall, to retain a layer of sediment to aid benthic recolonization; and ○ Leave undisturbed/pristine areas ('slivers or lanes/corridors') of the sediment to aid benthic recolonization. ○ Measures taken to increase dilution and reduce plume dispersion zone of impact (discharge below keel at -15 m and use of environmental valve system).
Protection of water column from increased concentrations of	– Monitor the existence and abundance of sulphur oxidizing bacterial mats in the proposed dredging areas pre and post, ore recovery operations.

H_2S	– Surveys at impact and reference sites to be done pre-dredging as part of the updating of the existing baseline reference data and then at sequential 3-year intervals until an apparent stable condition has been attained. – Pore water free sulphide concentrations to be confirmed from fresh sediment obtained by a large GOMEX box core. Pore water is to be extracted from replicate sub-cores without exposure to air or overlying water with a pore water extracting device and analysed spectrophotometrically within a short period after collection. – Essential that on-board air quality is monitored during recovery and production operations if operating in muddy areas.
Appropriate disposal of tailings	– Discharge tailings at 15 m or lower below the sea surface and utilization of the green valve system where possible, to increase the dilution of the sediment plume in the water column and reduce zone of influence of sediment plume dispersion.
Reduce change in local near bottom hydrographical conditions	– Leave behind a residual sediment layer overlying the footwall substrate of at least 30 cm. Routine pre and post dredging surveys to monitor natural recovery and re-sedimentation processes
Protection of upper water column from toxic sediment exposure	– As part of the updating of baseline reference data, toxicity tests to be conducted on fresh sediments collected by box core. The sampling method needs to ensure that surficial sediments are retained in the samples submitted for toxicity testing. It is recommended that a large GOMEX box core is employed for this due to its ability to achieve this when properly deployed.
Decrease risk of proliferation of human health hazardous bacterium	– Health risk of potential proliferation of hazardous anaerobic bacterium from the dredged area and its uptake to the food chain as a result of dredging at the annual scale is assessed to be of low significance and a rare probability. Any impact effects would be restricted to the annual mine site (1.7 km^2 on average) and short term. No in-situ contamination of fish populations by these bacterium have been reported for southern African fish populations. – Monitor water column, sediment and benthos characteristics to assess oxygen levels and indications of anoxic conditions at mine site.
Reduction of sediment plumes generated by dredger	– Discharge dredger sediment below keel depth (approx. -15 m) to increase dilution and reduce surface plume – Ensure that the environmental valve is employed where and when possible, in the dredging programme.
Monitoring requirements for surficial sediments –	– For the target 20 year planned dredged area: biogeochemical, macrofauna meiofauna and thiobacteria, sediment sample collection for:

chemistry, fauna and thiobacteria	○ Representative macrofaunal communities ○ Representative meiofaunal communities ○ Representative thiobacteria communities ○ Surficial sediment sample collection; texture and particle size, porosity, particulate organic matter, particulate organic carbon, total nitrogen, total phosphorus, trace metal concentrations, acid volatile sulphides (AVS), particulate organic carbon (POC) ○ Identify areas of actual and potentially high sedimentation (inhibiting benthos recovery via smothering or particulate organic matter build up and possible anoxia) ○ Determining benthos recovery / re-colonisation/ functional recovery rates post dredging disturbance will be photographically monitored in conjunction with above mentioned surveys by ROV and AUV. ○ Thiobacteria characterisation ○ Biogeochemical characterisation ○ Revise future ecological recovery monitoring programmes; ○ Retain data and interpretations on an environmental database system
Monitoring requirements for SP-01 surficial sediments – Chemistry, Fauna and Thiobacteria	– Conduct geophysical surveys post dredging on an annual basis, to determine / provide information on: ○ Area and volume (thickness) of sediment removed versus predicted; ○ Residual volume (thickness) of sediment covering the footwall ○ Integrate output information into adjustments for the next period of dredging; and ○ Retain data and interpretations on an environmental information database system. – Determining benthos recovery / re-colonisation/ functional recovery rates – Revise future ecological recovery monitoring programmes; – Retain data and interpretations on an environmental database system
Monitoring requirements for ML170 Target Mining Areas SP2 and SP3 for fish, mammals, seabirds, jellyfish and biodiversity – trawl survey	– In each of the target dredge area, biodiversity survey prior to and after each 20-year mine plan dredging campaign using monkfish trawl gear, for the collection of: ○ Demersal commercial and non-commercial fish species ○ Epifauna ○ Identification and biological characterisation of the fish and epifauna ○ Marine mammals, seabirds and jellyfish sightings ○ Mesopelagic fish and zooplankton presence, determined via acoustics and augmented by satellite imagery ○ Noise assessment water column characterisation (CTD) ○ Fish samples for heavy metal testing ○ General ocean / atmospheric (metocean) conditions
Monitoring: fish, mammals, seabirds, jellyfish and	– Appointment of vessel based Environmental manager from the dredger to observe, collect and record the following data/information: ○ Noise assessments

biodiversity – dredge vessel	○ General ocean / atmospheric conditions ○ Marine mammals, seabirds and jellyfish sightings ○ General operational status of the dredger ○ Record the number of mammals, species of birds and jellyfish aggregations sighted. ○ Monitor the affected area using geophysical and/or biogeochemical and benthic sampling techniques to assess recovery / re-colonisation and residual sediment distribution ○ Record general vessel operational activities
Monitoring of biodiversity specific to SP-01	– Appointment of vessel based Environmental manager for the dredger to observe, collect and record the following data/information: ○ Noise assessments ○ General ocean / atmospheric conditions ○ General operational status of the dredger ○ Record the number of mammals, species of birds and jellyfish aggregations sighted. ○ Monitor the affected area using geophysical and/or biogeochemical and benthic sampling techniques to assess recovery / re-colonisation and residual sediment distribution ○ Record general vessel operational activities

7.5 MARINE BIODIVERSITY MONITORING

The monitoring program will comprise 1) pre-dredging update of the existing baseline survey data on sediment properties, benthic macrofauna, associated biological communities, as well as radionuclide concentrations, and 2) regular monitoring surveys after the commencement of operations to support ongoing renewal of the environmental clearance certificate (Japp, 2022). The pre-dredging survey will provide a fresh set of reference data to update that established in the 2014 verification programme. The survey will be conducted in the 12–24-month period following granting of the EC during the development of the on-land facilities for ore processing and before the commencement of dredging operations in ML 170. Monitoring surveys will be completed then at 3 yearly intervals from the commencement of operations within the 3-year term of the current environmental clearance certificate. This will be followed by surveys in the 1st, 4th, 7th, and 13th years of dredging. Survey timing and specifications may be revised according to the results obtained.

However, radionuclide monitoring baseline surveys should be conducted prior to the commencement of dredging and repeated in year 3 and year 6 after the commencement of operations. It is important to bear in mind that the baseline and operation monitoring measurements of any influence on the impacts of radionuclides or the increase or decrease of radiation levels will be difficult to differentiate in the water column from dredging or other anthropogenic factors, or from natural occurrences, due to a variety of both other naturally occurring and anthropogenic pollution impacts on radiation levels in ML 170, which is not the onus of the Proponent to monitor.

To assess and quantify the radionuclide concentrations on the seabed and in the water column (plume) at different depths, and to improve the understanding of the impact that radionuclides have on the environment, elemental analysis and an radionuclide analyses will be conducted by using an accredited analysis laboratory, in that specific standard for testing. To this end, multiple samples of ~100 grams each, or more, should be sampled (but no more than 1 kg per sample). The samples should be packaged in plastic bottles or stable plastic bags, glass jars should not be used.

The surveys will be conducted in and around the 20-year mine plan dredging area in the SP1 target area (Figure 2). Monitoring in SP1 should be undertaken at regular intervals during and after completion of dredging of the 20-year mine plan area to determine the (functional) recovery rates of the benthic communities. Sample sites will comprise impact and reference locations distributed in a cross- and long-shore oriented grid based on the simulation modelling predicted sediment deposition zone of influence (ZOI) and those established in the verification surveys. The reference sites are those for benthos monitoring located north of the predicted ZOI as there are currently no seabed data south of the SP1 20-year mine area. The benthos impact sites are included in the sample set in the north of the 20-year mine plan area (Carter & Steffani, 2021).

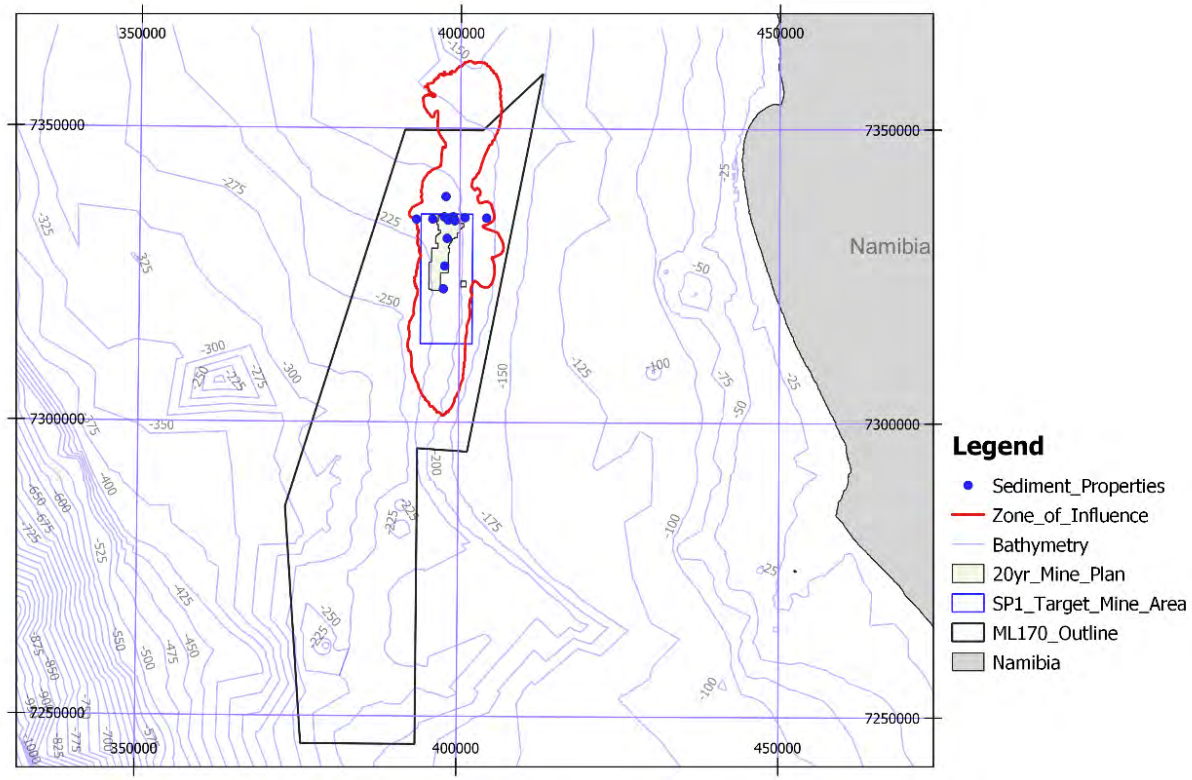

Figure 2 – Distribution of sediment sampling sites for baseline and monitoring surveys in SP1, indicated as blue circles. Red lines indicate the boundaries of the ZOI from simulation modelling (HR Wallingford, 2020)

The impact sites have been selected according to the currently proposed mine schedule to fall into the mine blocks that will be mined in year 1 and year 2 of the schedule (Figure 3). The

reference sites were chosen in relation to the predicted re-deposition rates (see Figure 2) to ensure that they remain unaffected by dredging activities over the 20-year mining. The positions of the impact and reference sites depicted in Figure 3 are schematic only and the final positioning should be decided on in collaboration with NMP's mine planners before the baseline survey commences (Carter & Steffani, 2021).

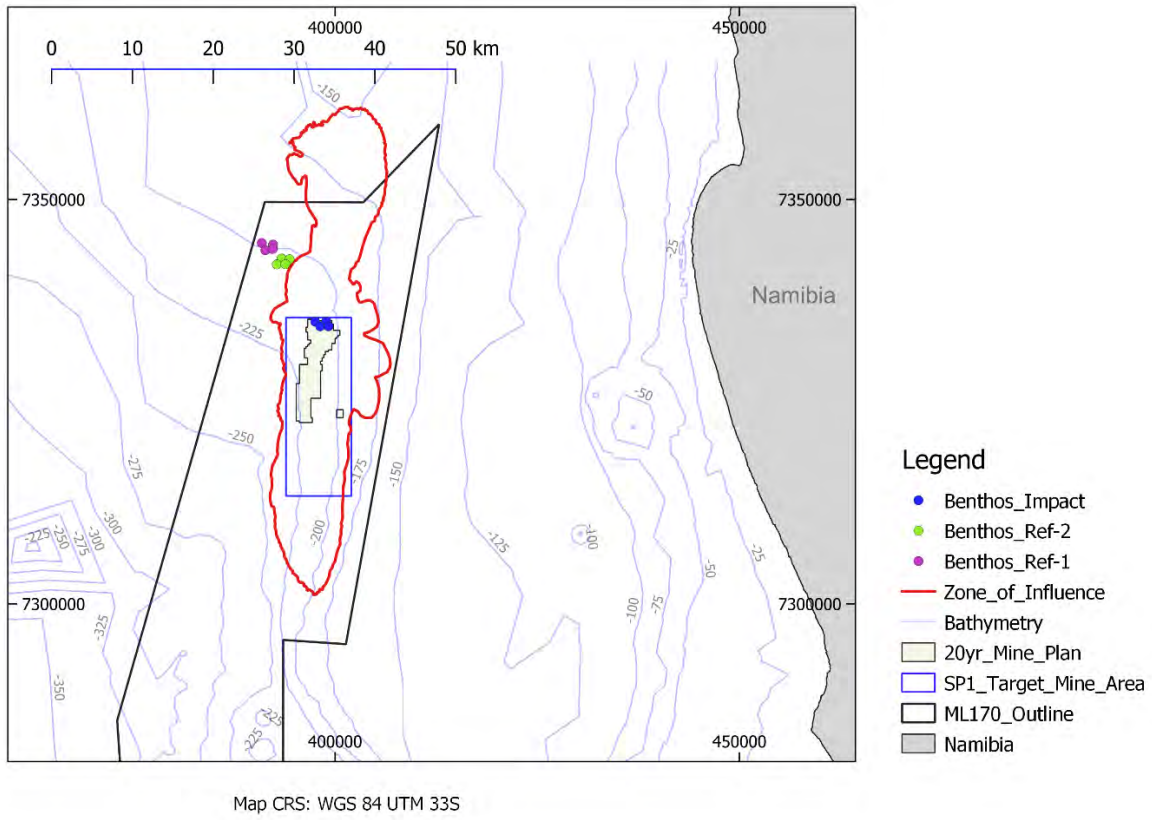

Figure 3 - Map of SP1 showing provisional macrobenthos impact and reference sampling locations (HR Wallingford, 2020)

The monitoring objective will be to assess the degree of change and its progression against the updated environmental baseline. The monitoring target will be the surficial sediments as the major effects are expected to be exerted on these through, e.g., sedimentation and smothering effects from sediments suspended at the dredge head and the rapidly sinking coarser fractions of the sediments in the lean water discharges from the TSHD hoppers during dredging.

Every effort should be made to ensure that negative impacts to the seabed due to dredging operations are kept to an absolute minimum. A benthic macrofauna and meiofauna monitoring programme is to be established and has been included in the EMP, the principal objective of which is to study the changes from the baseline condition to confirm spatial variations in the individual variables. This will also be used to assess the recovery of disturbed

macrofaunal and meiofauna communities once the dredging activity has ceased in a particular dredged area (De Nul, 2022).

This can be achieved by implementing strict management and mitigation measure and following up on the immediate impacts through continuous monitoring as outlined. All data collected from continuous monitoring will be retained and issued to all competent authorities and within statutory defined timeframes (Carter & Steffani, 2021).

8 WASTE MANAGEMENT PROGRAMME

8.1 INTRODUCTION

Any waste generated in the course of dredging activities on the dredging vessel will be managed in strict compliance with the provisions of the MARPOL convention Annex V by the dredging contractor. Non-mineral waste and domestic waste may be produced as by-products of dredging operations and will have to be managed appropriately. All non-mineral waste will eventually be removed when the vessel docks on land and will be disposed of at either the Walvis Bay landfill or hazardous waste site. If NamPort provides this service then records should be maintained of safe disposal.

Objectives

This waste management programme reflects the provisions of the MARPOL convention Annexure V designed to ensure the proper storage, transport, treatment and disposal of waste and where possible will also follow a waste hierarchy, which encourages waste avoidance and waste reduction followed by reuse, recycling and reclamation, before waste treatment and waste disposal as shown in Table 6 in Section 8.3.

8.2 ROLES AND RESPONSIBILITIES

WORKFORCE AND ALL CONTRACTORS

- Required to ensure that all waste generated during mining activities is handled appropriately onboard, removed and disposed of accordingly including providing evidence in the form of waste transfer receipts for the waste moved off-site
- Ensure no windblown rubbish pollutes the environment
- Remove waste on a regular basis to prevent vermin
- Try to minimize the amount of waste produced as far as possible.

VESSEL CAPTAIN AND ENVIRONMENTAL MANAGER

- Required to inspect receipts and evidence of correct waste handling
- Review waste management practices regularly during the vessel operations.

8.3 SOLID AND LIQUID NON-MINERAL WASTE

Where possible the Proponent will implement measures to reduce, reuse and recycle waste generated as part of the operations of the vessel. To achieve this a temporary waste storage facility will be required.

Waste will be controlled through prevention and mitigation measures as follows:

- Reduce, reuse and recycle where possible
- Storage of domestic waste to be done in accordance with MARPOL requirements, in separate bins for plastic, metal, general/food and recycling on site to avoid the

attraction of unwanted scavengers and will be offloaded in port to be disposed of at the accredited sites

- Hydrocarbon and chemical contaminated solids will also be stored onboard the vessel in accordance with MARPOL provisions and discharged of in port at designated sites using accredited service providers located through the correct channels and authorities. Some of these materials can be recycled or used by other facilities.

Table 6 - Waste Mitigation Measures

Responsibility	– Mining manager – Vessel Captain – OHSE appointed person /Environmental manager – Employees – Contractors
Potential issues or impacts	– Ocean water contamination due to spillage – Water pollution – Loss of marine biodiversity – Infectious diseases
Waste Management Plan	The Proponent will develop a waste management plan that complies with the MARPOL convention and based on the principle of "Nothing Overboard" and which should address as a minimum the mitigation measures included below
Proper disposal of waste (solid, oily, sewage – including bilge discharges to the sea)	– The oil content of any discharge is required to be less than 15 ppm (MARPOL: Annex 1). – Galley wastes discharged overboard only after maceration through a 25 mm screen (MARPOL: Annex V). – Sewage processed in approved treatment plants (MARPOL: Annex IV). – Do not discharge any treated or untreated sewage from a vessel within 4 nautical miles (nm) of land, but comminuted and disinfected sewage may be discharged beyond 4 nautical miles. – Only incinerated wastes may be discharged overboard and then only when the vessel is more than 25 nautical miles from shore. – With the exception of macerated galley and incinerated wastes, do not dump or throw solid waste of any kind into the sea. – Do not discharge any hydrocarbon products into the sea. – Maintain a register of all wastes discharged to sea and audit on a regular basis. – Contain all oils, grease or hydraulic fluids spilled on the vessel for disposal at a recognised land-based disposal site.

Waste disposal within harbour limits	– Do not dump or throw any solid waste of any kind into harbours. – Do not discharge any sewage into harbours. – Do not discharge any oily or waxy effluents into a harbour. – Do not discharge effluent or water from any tank contaminated with greater than 15 ppm of oil into a harbour. – Separate wastes into recyclable and "other" materials. Incinerate combustible materials on board. Store the balance in leak-proof skips for safe transfer to a registered waste site on land or contain all in leak-proof containers onboard and dispose at a recognised disposal site on a regular basis.
Management of hydrocarbons	Keep records (vessel logbooks) of quantities and types of all hazardous materials and hydrocarbons taken onboard vessels, their method of storage, use and disposal.
Discharge of ballast water	– Ballast discharges are controlled through the ISM approved Shipboard Ballast Management Plan (IMO guidelines on ballast water management). – Ballast water may only be released when the vessel is more than 20km from land and in water depths greater than 25m.
Discharges to the atmosphere	– NOx, SOx and VOCs are to be compliant with the requirements of MARPOL: Annex VI. – Only MARPOL approved incinerators may be used, and incineration may only take place according to MARPOL: Annex VI. – Use environmentally friendly substitutes for CFCs where feasible. – Phase out all use of ozone-depleting substances and equipment (refrigerators, engines etc.) with alternatives as per the Montreal Protocol on Ozone Depleting Substance as well as United Nations (UN) Framework convention on Climate Change 1997. – CO_2 emissions accounted for should be included in the land-based operations emissions inventory to determine cumulative impacts of CO_2 emissions.
General waste	– The vessel should be always kept tidy. All domestic and general waste produced daily should be contained: o No waste is to be left uncontained, in suitable containers, overnight. o Waste containers (bins) should be emptied regularly and removed from site to the nearest official waste disposal site. All recyclable waste needs to be taken to the nearest recycling depot if available. o A sufficient number of separate waste containers (bins) for hazardous and domestic/general waste must be provided on site. These should be clearly marked as such. o Mining personnel should be sensitised to dispose of waste in a responsible manner and not to litter.

	○ No waste may remain on site after the completion of dredging.
Residual mineral samples	– Samples that will not be used for further analysis or submitted to MME should be taken off site or used. – No samples are to be dumped at site or in the vicinity of the site as to not affect rehabilitation efficiency through physical and chemical pollution of weathering samples.
Littering and environmental contamination from waste	– No littering by workers shall be allowed. – All litter on and around the site must be picked up and placed in the bins provided. – The site should be always kept tidy and free of litter. All domestic and general waste produced daily should be cleaned and contained daily. – No waste shall be burned unless permitted to do so. – Waste shall be collected and shall be removed regularly to avoid bad odours. – Hazardous and non-hazardous waste shall be always stored separately.
Environmental contamination from liquid waste	– Hydrocarbon and chemical contaminated solids must be stored correctly and disposed of by registered companies. – Safe disposal certificates must be kept and provided to the vessel captain on request.
Waste management record keeping	– Maintain a waste record book of all discharged/ incinerated food and domestic and operational waste (excluding oil, sewage or noxious liquids listed in other annexes to MARPOL). – Record waste in the record book under the categories of: i) plastics, ii) floating dunnage, lining or packaging material, iii) ground-down paper products, rags, glass, metal, bottles, crockery, etc., iv) paper products, rags, glass, metal, bottles, crockery, etc., v) food waste, vi) incinerator ash. – As per the prescribed form, record estimated amounts (m3) of each category whenever waste is discharged to sea, or to reception facility ashore or to other ships, or incinerated, or in accidental or other exceptional discharge. Also record date/time of discharge/ occurrence, position of ship, and nature of discharge (incineration/ port/ facility/ name of ship) or circumstances and reasons for accidental or other exceptional discharge. – Environmental manager in charge is to sign each record on the date of incineration or discharge, and the Vessel Captain of the vessel is to sign each completed page of the waste record book.

Monitoring Requirements	1. Monitor whether the provisions set out in this EMP concerning waste management, is being applied as per instructions. 2. Maintain waste record book for all discharges of wastes and incinerations. 3. All non-compliances should be recorded and discussed at weekly site meetings and timeous remedial actions taken. 4. All guilty parties that are in contravention of the provisions set out for managing waste should be given a penalty and according to the severity of the impact appropriate steps taken.

8.4 WASTE DISPOSAL MONITORING

Certificates providing details of the safe disposal of waste from a permitted hazardous waste disposal site must be provided to the Vessel Captain upon request.

9 SPILL MANAGEMENT PLAN

9.1 INTRODUCTION

The uncontrolled release of fuels and other chemicals has the potential to cause contamination of the ocean which may lead to serious environmental harm. On this basis, the storage and use of fuels or other chemicals must be managed to the strictest compliance to MARPOL standards to minimise the risk of a release and measures must be in place to promptly address impacts should a release occur.

9.2 OBJECTIVES

This spill management plan has been prepared to minimise the potential for the uncontrolled release of fuels, oils and other chemicals. Preventative measures to minimise the potential for a spill are listed. Should a spill occur, this plan provides guidance for the Proponent on the appropriate spill response measures and fall under the provisions of MARPOL. The vessel will also be appropriately equipped to manage any spills and will have an emergency response plan as shown in Table 7 and Table 8 in Section 9.5.

9.3 ROLES AND RESPONSIBILITIES

Roles	Responsibility
Vessel Captain/Environmental manager	Required to ensure that appropriate spill prevention measures are implemented and that any spills have been appropriately managed and reported (see 9.4.).
Workforce and all contractors	Required to implement the spill prevention and response measures listed below.

9.4 SPILL PREVENTION MEASURES

The following management measures are to be implemented by the Proponent:

- Spill kits are to be made available throughout the site. The kits are to include, as a minimum, the following items:
  - Absorbent materials
  - Shovels
  - Heavy-duty plastic bags
  - Protective clothing (e.g., gloves and overalls)
- Major servicing of equipment shall be undertaken off site or in appropriately equipped workshops
- Provision of adequate and frequent training on spill management, spill response and refuelling must be provided to all onsite staff and contractors

- Fuels, lubricants, and chemicals are to be stored within appropriately sized, impermeable bunds or trays with a capacity not less than 110% of the total volume of products stored
- All fuel and chemical storage and handling equipment (including transfer hoses, etc.) shall be well maintained
- Storage and handling of fuels and chemicals shall be in compliance with relevant legislation and regulations
- MSDS are to be kept for each chemical used on site. These must be easily accessible to all personnel.

9.5 SPILL RESPONSE MEASURES

The primary concern, in the event of any spill, is the health and safety of any employees and contractors in the vicinity. Of secondary, but highly significant, importance, is the protection of the marine environment.

The following points therefore apply to all areas on the vessel:

- Assess the situation for potential hazards
- Do not come into contact with the spilled substance until it has been characterised and necessary personal protective equipment (PPE) is provided
- Isolate the area as required
- Notify the vessel captain, OHSE manager or Environmental manager.

The following measures are to be implemented in response to a spill on the vessel:

- Spills are to be stopped at source as soon as possible (e.g., close valve or upright drum)
- Spilt material is to be contained to the smallest area possible using a combination of absorbent material or other containment methods
- Spilt material is to be recovered as soon as possible using appropriate equipment
- All contaminated materials recovered subsequent to a spill e.g., absorbent pads are to be disposed to appropriately licenced facilities
- The OHSE manager or environmental manager are to be informed as soon as possible in the event of a spill
- A written Incident Report must be submitted to the vessel captain and environmental manager.

The following measures are to be implemented in response to a spill in the ocean:

- The OHSE manager or environmental manager are to be informed as soon as possible in the event of a spill
- Spills are to be stopped at source as soon as possible (e.g., close valve or upright drum)
- Spilt material is to be contained to the smallest area possible using a combination of absorbent material or other containment methods
- Booms: Long, floating, interconnected barriers are used to minimize the spread of spill

- Sorbents: Specialized absorbent materials act like a sponge to pick up oil but not watered oil.

Table 7 - Spill mitigation measures

Responsibility	– Vessel Captain – Mining manager – Employees – Contractors
Potential issues or impacts	Seawater contamination due to spillage.
Stored hazardous chemicals	– Hazardous chemicals (such as fuels) are to be handled over areas provided with impervious surfaces. – Spills of hazardous chemicals are to be contained and cleaned-up to ensure protection of the environment. – All the necessary PPE required for the safe handling and use of petrochemicals and oils shall be provided to and used or worn by the onsite staff.
Machinery and equipment maintenance	– Major servicing of equipment shall be undertaken off-site or in appropriately equipped workshops. – For small repairs and required maintenance activities all reasonable precautions to avoid oil and fuel spills must be taken (e.g., spill trays, impervious sheets). – All the necessary PPE required for maintenance activities must be issued to staff whose duty it is to manage and maintain the machinery and equipment.
Management of hydrocarbons	– Keep records (vessel logbooks) of quantities and types of all hazardous materials and oils taken onboard vessels, their method of storage, use and disposal.
Prevention of small oil or cleaning solvent spills onboard	– Use low toxicity biodegradable detergents to clean up spills. – Avoid spilling toxic chemicals but if spillages occur then clean up spilled chemicals immediately and place adsorbent material (rags) used for this purpose in sealed waste containers for safe disposal ashore. – Keep records of spillages and estimate amounts not retrieved by clean up actions.

Table 8 below shows the environmental aspects and impacts, mitigation and monitoring measures for the spill of hazardous substances.

Table 8 - Spill of hazardous substances

Responsibility	– Vessel Captain – Mining manager – Contractors	
Potential issues or impacts	Hydrocarbon, chemical handling and storage can cause spillages that lead to seawater contamination.	
Management/ mitigation measures	Safe delivery and handling	1. Appropriate emergency response plan and environmental response plan to be in place, per MARPOL requirements 2. Good housekeeping across the site. 3. Fuel and chemicals are handled with care. 4. Spill kits to be at designated areas across the site or available for use during refuelling, fuel/chemical delivery, or use. Absorption material should be available and at hand 5. Any major spill is reported once containment has been achieved. 6. Vessel and equipment to be well maintained and serviced regularly.
	Storage	Spill kits available at storage locations and around the site at suitable locations.
Monitoring requirements	Hazardous substances	Maintain records of quantities used and disposed.
	Leaks and Spills	Maintain records of all spills and remedial actions.
	Hydrocarbon consumption	Maintain records of oil and fuel consumption.

For large-scale spills and other significant environmental incidents, the fire services should be contacted as required and the office of the Ministry of Environment and Tourism (MEFT) informed of the incident (telephone +264 61 284 2111) and Marine Resources (MFMR) (telephone +264 61 2053911). All correspondence with MEFT should be undertaken by the vessel captain with support from the OHSE/Environmental manager, Vessel Captain, Mining manager and Chief Operations Officer, for spillages inside the port, NamPort OHSE department to be notified.

For the clean-up of smaller spills, the relevant material safety data sheet (MSDS) should be consulted to determine the appropriate clean-up procedure. Basic spill response training will be provided as part of the site environmental induction, spill response equipment, including

relevant MSDS copies, will be provided in areas where potentially environmentally hazardous chemicals may be used.

9.6 SPILL REPORTING

All major petroleum product spills (≥200 L) should be reported to the Ministry of Mines and Energy (MME) on Form PP/11 titled "Reporting of major petroleum product spill", issued by the Ministry.

10 AIR QUALITY MANAGEMENT PLAN

10.1 INTRODUCTION

This air quality management plan describes the strategies and procedures that will be implemented to ensure the prevention of air pollution from elevated concentrations of gaseous emissions (e.g., oxides of nitrogen; nitrogen dioxide, particulate matter; sulphur dioxide and carbon monoxide) in accordance with MARPOL Annexure VI shown in Table 9 in Section 10.4. Gaseous emissions result primarily from the exhaust of the vessel main engines. In cases where generators and other machinery are used, there will be some release of exhaust fumes that will impact the immediate vicinity but will be of short duration.

10.2 OBJECTIVES

This air quality management plan has been prepared to monitor and prevent deterioration of air quality and to minimise the potential for airborne pollutants. Preventative measures are listed below.

10.3 RESPONSIBILITIES

WORKFORCE AND ALL CONTRACTORS

To implement the necessary management practices in order to meet the objectives listed above.

ENVIRONMENTAL MANAGER

To ensure that the objectives listed above are being met and to provide performance feedback to the mining manager.

10.4 AIR QUALITY MANAGEMENT PROCEDURES

Table 9 - Air quality mitigation measures

Responsibility	– Vessel Captain – Mining manager – Contractors
Potential issues or impacts	– Air pollution
Management of fumes	– On-board air quality monitoring during dredging to identify and manage if required, any unexpected hydrogen sulphide concentrations. – Ensure that vessel undergoes regular maintenance and is serviced when required.

10.5 AIR QUALITY MONITORING

Emissions onboard the vessel will be managed in accordance with the provisions of MARPOL.

10.6 NOISE AND VIBRATION IMPACTS

The sensitive receptors within proximity to the mining/dredging operation will be the marine fauna. Vessel dredging operations have the potential to generate noise and vibration that can impact marine fauna. Table 10 below outlines the potential environmental impacts, mitigation and monitoring measures for noise related aspects of the operations.

Table 10 – Noise aspects

Responsibility	– Mining manager – Vessel Captain – Contractors
Potential issues or impacts	Potential disturbance and/or damage to marine mammals and fish hearing organs through sustained exposure.
Management/ mitigation measures	– Initiate the marine sightings programme (birds, mammals, and jellyfish). – Record the numbers and species sighted during all activities associated with the dredging operation. – Avoid disturbances of whales whilst underway.
Monitoring requirements	1. Noise assessment modelling of the dredging vessel. 2. Noise assessment measurements and profiling during the operational phase from the vessel. 3. Sources of excessive noise will be investigated if detected, and recommendations made for mitigation.

10.7 NOISE AND VIBRATION MONITORING

Currently, specifications for international and/or national noise emission limits for dredging operations is limited however there is substantial research available on noise and potential impacts on marine mammals and fish in published literature. Sound receptors in the operations area will be mainly cetaceans, seals, and fish. Temporary (hearing) threshold shift (TTS) in cetaceans and seals are reported as being 175 dB re 1µPa at 1 m SPL received level and above. Mortality can be caused in fishes at SPL >207 dB re 1µPa at 1m for fish with swim bladders and >213 for fish without bladders, TTS thresholds are ≥186 dB; mortality in fish eggs and larvae can occur after exposure to 207 dB (Popper and Hawkins, 2019). Given the dredger sound source levels noted below. such effects are unlikely.

The project's preferred dredging operator, Jan De Nul has compiled detailed sound profiles for operating Trailing Suction Hopper Dredgers in the dredge fleet that it operates (of specifications to the dredger to be used in ML 170) and measured and modelled sound attenuation. Sound (SPL) source levels for an operating TSHD in the Jan De Nul fleet are 180 to190 dB re 1 µPa at 1m, dominant sources are main engine (500 Hz) and propeller (300 Hz). Measurements around an operating TSHD show that produced sound attenuates to 150 dB within 100 m distance from the dredger.

While relevant sound propagation and intensity modelling has been done, the requirement remains for onsite operational monitoring will still need to be undertaken as definitive characterisation of the noise emission profile for the dredger is affected by many variables including water salinity, depth, seabed sediment, currents, turbidity etc.

In this regard acoustic measurements should undertake onsite in ML170 in prevailing water and seabed conditions once operations commence.

Acoustic data should be collected with Passive acoustic monitoring (PAM) devices (e.g., hydrophones) during three primary operational periods:

- While the vessel is in full dredging operation
- During the lowering and hoisting of the trailing arm
- While the vessel is sailing to or from site.

This approach is to be formalised such that noise attenuation at stand-off distances is measured by hydrophone deployments. Distances can be 500 m, 1,000 m, 2,500 m, 5,000 m and 10,000 m. During these measurements 'source' levels at the operating dredger need to be measured simultaneously. The purpose is to confirm measured and modelled attenuation rates supplied by the dredging contractor. This can only be carried out once the dredger is actively operating onsite in ML 170.

This process will determine the actual dredging noise profile and the attenuation from the sound source (e.g., the vessel). This will assist in confirming the findings of the baseline data completed to date regarding the impact on marine mammals and seabirds and related potential for harm.

It is recommended that during daylight hours marine mammal sightings and seabird observations within a 500 m radius of the vessel be recorded for six hours per day, irrespective of the operational status (De Nul, 2020).

11 ARCHAEOLOGICAL AND HERITAGE PROGRAMME

The "chance finds" procedure covers the actions to be taken in the event of the discovery of a heritage site or item in regard to its investigation and assessment by a trained archaeologist or other appropriately qualified person. In the case of the marine environment, potential chance finds mostly relate to unidentified shipwrecks. Review of all available archaeological data to date show no records of shipwrecks reported in the define mine plan area or surrounds.

The "chance finds" procedure is intended to ensure compliance with relevant provisions of the National Heritage Act, No. 27 of 2004), especially Section 55 (4): "a person who discovers any archaeological object must as soon as practicable report the discovery to the Council". The procedure of reporting set out below must be observed so that heritage remains reported to the NHC are correctly identified in the field. Table 11 below shows the environmental aspects and impacts, and mitigation and monitoring measures for archaeological and heritage aspects.

Table 11– Archaeological and heritage aspects

Responsibility	– Mining manager – Vessel Captain – Contractors
Potential issues or impacts	Impact on heritage features
Management/mitigation measures	– Should a heritage site or archaeological site be uncovered or discovered during dredging activities, a "chance find" procedure should be applied in the order they appear below: o If operating machinery or equipment, stop work o Determine GPS position if possible o Report findings, site location and actions taken to mining and vessel manager o Cease any dredging operations in immediate vicinity o Determine and demarcate the exclusion boundary o Site location and details to be added to the project's geographic o information system (GIS) for field confirmation by an archaeologist o Inspect site and confirm addition to project GIS o Advise the National Heritage Council (NHC) and request written permission to remove findings from work area, if possible – Recover, package and label findings for transfer to the National Museum, is possible.

	– Should human remains be found, the following actions will be required: o Apply the chance find procedure as described above o Schedule a field inspection with an archaeologist to confirm that remains are human o Advise and liaise with the NHC and Police o Remains will be recovered and removed to either the National o Museum or the national forensic laboratory. – Contact person at NHC: Rev. Soloman April; Tel: (061) 244 375/ 385/594
SPECIFIC MITIGATION DETAILS	
Monitoring requirements	1. If a site is discovered, make sure the archaeological site is not disturbed without permission or supervision of NHC. 2. If authorized to proceed, make sure everything of importance, as identified by an appropriate specialist, is removed from site (if possible), and declared safe by an archaeologist before nor dredging operation can continue inside the perimeter of the defined archaeological site.

11.1 RESPONSIBILITY

Dredging Operator - To exercise due caution if archaeological remains are found
Mining manager - To secure site and advise management timeously
Vessel Manager - To determine safe working boundary and request inspection
Archaeologist - To inspect, identify, advise management, and recover remains (if possible)

12 IMPLEMENTATION OF THE EMP

This environmental management plan:

A. Has been prepared according to the scope of work and terms of appointment issued to the EAP by the Proponent
B. Has been prepared based on information provided to or obtained by ECC up to October 2022
C. Is for the sole use of the Proponent, for the sole purpose of an EMP
D. Must not be used (1) by any person other than the Proponent or (2) for a purpose other than an EMP
E. Must not be copied without the prior written permission of ECC
F. Will be updated pending the outcome of the impact assessment report review and the application process for the environmental clearance certificate for the Project.

13 REFERENCES

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APPENDIX A - JAN DE NUL ENVIRONMENTAL MANAGEMENT PRACTICES

CLIENT:

NAMIBIAN MARINE PHOSPHATE (PTY) LTD

CONTRACTOR:

JAN DE NUL N.V.

PROJECT NAME:

SANDPIPER PHOSPHATE PROJECT

DOCUMENT TITLE:

ENVIRONMENTAL IMPACTS OF DREDGING ACTIVITIES AND MITIGATION MEASURES

Document no.: PS.NAM-PA-22.001-DUKR-1

1	31-3-2022	Draft version	DUKR	FJ	MW	
Rev.	Date	Description of revision	Prepared	Checked	Approved	
			Jan De Nul			

1 Introduction

Namibia Marine Phospate (NMP) is holding licenses to explore phosphate deposits along the Namibian Coast and has an agreement with dredging contractor Jan De Nul Group (JDN) to excavate these phosphate rich deposits at water depths of 180m to 300m. The phosphate deposit is a 1 to 3m thick superficial layer of fine-grained francolite minerals (150-250 µm) mixed with shell fragments. The deposit overlays a clay footwall.

The trailing suction hopper dredger (TSHD) is the most convenient equipment to extract the phosphate deposit. The phosphate dredging process is identical to dredging of sand from the seabed: The sand is mixed with water and pumped through a suction pipe. The sand settles in the ships' hold, the transport water containing suspended solids is returned to the sea.

The impact of the dredging activities is well studied and is different for each site, depending on current and wave conditions, water depth and oxygen levels [1]. This document provides an overview of the worldwide experience of JDN (1) in adhering to international standards concerning dredging activities, and (2) implementing a range of monitoring techniques and mitigating measures to reduce the negative impact of dredging activities on the environment.

2 Overview of international regulations and standards

Dredging activities are located in national jurisdictions and are regulated by national legislation. Therefore, different regulations apply in different countries all over the world. Nevertheless, national legislation is usually based on international standards and guidelines, in particular in countries that ratified these international treaties, and which are as a consequence a "Contracting Party" of these international conventions. All internal processes at JDN are in line with these international regulations and standards.

The United Nations Convention on the Law of the Sea (UNCLOS) regulates activities on the seabed and ocean floor beyond the limits of national jurisdiction. Typical dredging related activities in international waters are trenching and backfilling of cables and pipelines and deepsea mining. The general provisions in UNCLOS Part XII state that member States are obligated to preserve and protect the marine environment through preventing, controlling, and reducing pollution. States are furthermore obligated to use the best practical means in accordance with a State's capabilities to prevent pollution from spreading outside a State's jurisdiction.

The London Convention of 1972, and the subsequent Protocol of 1996 on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter include regulations on dredged materials as matter that can be dumped, i.e. deliberately disposed of at sea. Secondly, the Convention of Biological Diversity requires its member states to conduct Environmental Impact Assessments (EIAs) for all "projects that are likely to have significant adverse effects on biological diversity" and

to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

On a regional level, the Noumea Convention (South Pacific Region) and the OSPAR Convention (North-East Atlantic) are noteworthy to mention. They impose a duty to prevent, reduce and control environmental damage resulting from sand extraction and dredging. OSPAR was amended by an agreement on sand and gravel extraction, which requires member states to take certain guidelines into account when engaging in sand mining. The amendment was compiled by the "International Council for the Exploration of the Sea" or ICES. In 2002, ICES adopted specific new Guidelines for the Management of Marine Sediment Extraction. These guidelines were adopted by OSPAR at the 2003 meeting of the Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT) [2].

General principles for the sustainable management of all mineral resources overall include [2]:

(1) conserving minerals as far as possible, whilst ensuring that there are adequate supplies to meet the demands of society;
(2) encouraging their efficient use (and, where appropriate, re-use), minimizing wastage and avoiding the use of higher quality materials where lower grade materials would suffice;
(3) ensuring that methods of extraction minimize the adverse effects on the environment, and preserve the overall quality of the environment once extraction has ceased;
(4) the encouragement of an ecosystem approach to the management of extraction activities and identification of areas suitable for extraction;
(5) protecting sensitive areas and important habitats (such as marine conservation areas) and industries (including fisheries) and the interests of other legitimate uses of the sea;
(6) preventing unnecessary sterilization of mineral resources by other forms of development.

Principles number 3-5 are the most important and relevant principles for the scope of the Sandpiper project. These principles are translated in concrete guidelines in the ICES Cooperative Research Report No. 263 [2].

In addition to the above guidelines, there are general requirements for pollution prevention in the marine environment by ships. The "1973 International Convention for the Prevention of Pollution from Ships" (MARPOL) was developed by the International Maritime Organization (IMO). The main goal of MARPOL is to prevent and minimize pollution from ships - both accidental and from routine operations. There have been a number of amendments to the Convention since it was first produced, and MARPOL now has six technical annexes covering marine pollution by:

- oil
- noxious liquid substances carried in bulk
- harmful substances carried in packaged form
- sewage from ships
- garbage from ships
- air pollution from ships

3 Impacts of dredging on the environment

The impacts relevant to dredging of phosphate sand with a trailer suction hopper dredger are:

- Removal of habitat
- Seabed disturbance
- Turbidity plumes
- Settlement of suspended solids
- Sound
- Light
- Emissions
- Waste

3.1 Removal of habitat

Description of the process:
In all sand and gravel dredging extraction activities, seabed substrate is removed. Because the seabed is the habitat of living species, the activity causes a physical loss of this habitat.

What is the impact?
Seabed habitats provide valuable ecosystem services to societies and industry in terms of food, raw materials, energy and space (e.g. fisheries). The removal of substrate has a direct impact on marine organisms because the habitat and the species it hosts are removed (see §3.1) or changed (see §3.2). Recolonization and recovery of disturbed areas is possible under certain conditions.

How is the impact monitored?
A project specific environmental monitoring and management plan is submitted and approved. Environmental criteria are often project specific. Hence, per project a specific environmental monitoring programme is configured. The environmental monitoring may consist of bathymetric surveys, studies of physical, chemical and biologic parameters, and may even include modelling of the hydrodynamic parameters to define and budget the footprint of the possible impact.

How does JDN reduce this impact?
Dredging activities are strictly limited to designated areas. This is monitored by the vessel's logging system.
The impact on the removal and quality of habitat for marine organisms during sand or gravel extraction projects can be reduced in different ways:

- Removal of only a part of the original seabed, leaving part of the original substrate in situ.
- Alternate mined areas with undisturbed areas.
- Active habitat restoration or habitat relocation.

Examples of monitoring programmes:

(1) *Project:* the Posorja project (Ecuador) included the dredging works of the outer access channel and turning basin for the multi-purpose terminal of the new deepwater port in Posorja.

Monitoring of marina fauna during dredging works: biannual marine fauna monitoring was executed during the wet and the dry season (September and January) by means of a bioaccumulation test of heavy metals, monitoring and ecological analysis of marine mammals, fish and macro benthos. Due to the presence of many marine mammals such as humpback whales, bottlenose dolphins and sea lions, awareness training was provided to all project staff. Characteristics, determination and what to do when coming across these animals during operation were discussed by means of an interactive presentation.

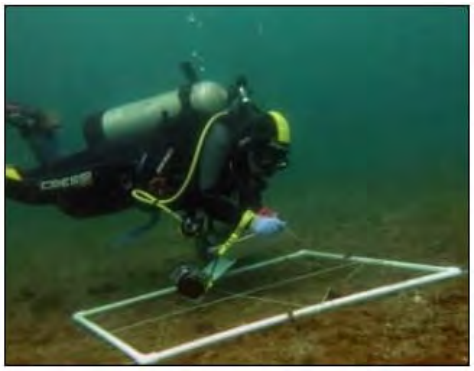
(2) *Project:* The Atlantic Dredging project is part of the expansion of the Panama Canal. This expansion plan entails the widening and deepening of the channel, as well as the construction of two new sets of locks.
Monitoring: Sensitive ecosystems (coral reefs and mangroves) are present near the project area. A baseline monitoring campaign was executed before the start of the project. During the activities the water quality, the turbidity plume, air quality, noise and vibration was monitored on a recurrent basis.

Community involvement: while implementing the Panama Canal expansion, JDN was responsible for the social management of the project. To this end, the necessary information sessions were held. The approach to complaints was taken care of by JDN.

(3) *Project:* for the First Phase of Kingston Container Terminal expansion project, Sodraco International (a Jan De Nul branch in Jamaica) was the Contractor in the Consortium responsible for the part of the Dredging Works.
Monitoring: prior to the dredging, baseline monitoring of sediment samples, water quality, turbidity and surveys needed to be conducted of the sensitive and surrounding area.
During the dredging the following monitoring was conducted: fixed and mobile turbidity and water quality monitoring stations with real-time transmission, turbidity plume monitoring, siltation monitoring spot checks with divers, aerial photographs were taken at regularly basis, and noise monitoring.
Community involvement: during the dredging works for the deepening and widening of the access channel to Kingston Jamaica, the client was responsible for all communication with the stakeholders. However, Jan De Nul offered work to the local fishing community (daily checking the status of the sludge screen for which a fixed amount was paid per completed checklist) as well as weekly representatives of the various stakeholders were invited on board the dredger to ensure transparency of our activities and the impact of our activities.

(4) *Project:* Dredging the access channel to the Cartagena Bay (Columbia)

Relocation of coral reef in Columbia: Compared to average dredging projects the environmental requirements on the Cartagena bay project were extensive. Possible impacts of the dredging activities were mitigated by a flora and fauna management that included extensive ecological monitoring of coral and seagrass areas. The dredge zone was a sandy area with some dispersed rock formations that were colonized with corals and sponges. Characterization was done following the methods of the National Monitoring System of the Coral Reefs of Colombia (SIMAC). In general, information was gathered on benthic cover (in terms of composition and structure), together with abundance of commercially and ecologically important mobile invertebrates and the species richness and abundance of fish. Additionally black coral abundance, sponge abundance and species richness, and structural complexity of the substrate were measured. Subsequently, the low mobility species of commercial and ecological importance were relocated from within the dredge area to appropriate receptor sites. The organisms that were relocated included six species of corals, two sponge species, sea urchins, sea cucumbers, lobsters, conches and some fish of low mobility such as seahorses, scorpion fish, porcupine fish, and batfish.



(5) *Restoration of oyster reefs in the North Sea:* once a key habitat in the North Sea, European flat oyster reefs have disappeared in the Belgian part of the North Sea due to a combination of factors, including overexploitation, destruction by bottom trawling and diseases such as bonamiosis. With the support of partners from 8 countries, 5 pilot projects have been set up. Jan De Nul participates in the research project in Belgium, which focuses on nature restoration and aquaculture, including an important initiative to restore the flat oyster reefs in the Belgian part of the North Sea.

What is the relevance for Sandpiper?

In order to monitor and reduce the potential impact of the Sandpiper project on the environment, the following steps are required:

1) Setting up a monitoring and management plan.
2) Implement the monitoring plan, and monitor before, during and after the dredging activities.
3) Minimizing the impact on the seabed by leaving part of the substrate in situ and/or in alternate dredging areas with reference areas.
4) Analyse the monitored data.
5) Adapt the dredging strategy, based on insights gathered about the response and reaction of the environment on the disturbance of the habitat.

3.2 Seabed disturbance

Description of the process

The physical disturbance of the seabed can be understood as a change to the seabed which can be restored if the activity causing the disturbance is stopped. Seabed disturbance is the results of physical modification of the seabed. Physical characteristics, such as the bathymetry, depth, waves, tidal currents, and sediment particle size are altered by dredging.

What is the impact?

The physical conditions of the seabed, such as water depth, exposure to wave action and tidal currents determine which species live on and in the seabed. Any change of the seabed bathymetry or the seabed composition will have impact on marine life, and thus on other activities such as commercial fishing. Depending on the specific local situation and the (relative) size of the changes, the speed of the recovery of the seabed will differ.

How is the impact monitored?

The impact on the seabed and the physical conditions is determined by monitoring of the following environmental parameters (before, during and after the activities):

- tide and wave data
- seabed composition
- bathymetric surveys to monitoring changes in the seabed during and after the dredging activities
- turbidity measurement can be considered, as under certain conditions the changes in the bathymetry might influence the hydrodynamics and as a consequence the turbidity in the water column

How does JDN reduce the impact?

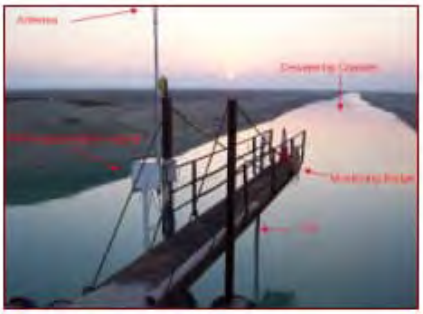
The monitoring campaign allows analyzing the undisturbed seabed, and is used to define a baseline situation, thresholds and limits. By preserving or even restoring the physical conditions as much as possible the impact of the physical changes is reduced.

Examples:

(1) *Project scope:* A key part of the Tourism Development & Investment Company (TDIC) strategy to significantly increase tourist visitation to Abu Dhabi, United Arab Emirates (UAE), is the development of Saadiyat Island, located immediately to the north-east of Abu Dhabi City, as a new tourism centre. The proposed development for Saadiyat Island includes a 1000-berth marina development on its southwestern shore, which will require considerable dredging and land reclamation.

Environmental monitoring: A baseline investigation was performed in accordance with the Construction Environmental Management Plan (CEMP) prior to the dredging and reclamation works to determine the hydrodynamic conditions, turbidity levels and the condition of the seagrass and mangrove c ommunities surrounding Saadiyat Island. Monitoring of the mangroves was done related to changes in the sedimentation-erosion ratios in the mangrove reference locations following the dredging and land reclamation works.

(2) *Project:* the objective of the project in the Mesaieed Port (Qatar) was to expand the existing import and storage facilities to ensure that the construction industry in Qatar could receive adequate quantities of gabbro aggregates to satisfy the growth in demand for the next 20 years.



Environmental monitoring: based on baseline monitoring, seabed composition and biological growth, a natural level of turbidity and suspended solids was determined, allowing to define a turbidity threshold value. During the dredging works the turbidity values were monitored by using 2 monitoring buoys in the vicinity of the dredger, i.e. at 300m from the dredger as requested by MoE. These buoys could be relocated depending on the dredger's working area with the use of a zodiac.
On top of the turbidity monitoring, monthly satellite pictures of the Mesaieed harbor had to be captured to visually quantify the generated turbidity plume of the CSD "JFJ De Nul" and the possible plume at the outflow of the dewatering channel.

What is the relevance for Sandpiper?
For the Sandpiper project the impact on the physical conditions of the seabed is expected to be limited taking into account the water depth of 180 to 300m and the limited thickness of 1-3m of the excavated substrate.
The monitoring programme, that foresees pre- and post-dredge bathymetry and analysis of samples, is part of an adaptive management programme.

3.3 Turbidity plumes

Description of the process

During the trailing suction hopper dredging works, a mixture of water, fine sand and fines is released through the overflow duct. The process therefore results in the release of suspended sediments into the water column referred to as sediment plumes.

What is the impact?

Excessive suspended sediment concentration has an impact on water transparency – as a result of increased turbidity – and may cause the degradation of water quality and marine ecosystems. The light intensity is a crucial factor in the primary productivity of seagrasses, plankton and algae. A reduction of the light intensity will influence (negatively) the primary production.
The turbidity plumes might have an impact on fish population. If the species is vagile, it can choose to move away from the sediment source once exposed. Impacts will therefore often depend life stage of the fishes.

How is the impact monitored?

Monitoring the impact of the turbidity plumes is done based on measurements of the turbidity, water quality, analysis of water samples and satellite images. The monitoring locations are chosen based on the identification of areas with sensitive species. The identification of these sensitive species, sensitive areas and periods is defined as part of the baseline monitoring programme.
The development of a hydrodynamic model allows to predict how the turbidity plume migrates in the water over time, which is valuable input for the adaptive dredging management.

How does JDN reduce the impact?

Mitigating the impacts of turbidity is managed by limiting the amount of suspended sediments released at the dredging sites and by limiting spreading into sensitive areas. Trailing suction hopper dredgers of JDN are equipped with an overflow duct releasing the sediment through the bottom of the ship, rather than on the surface. Inside the overflow duct, a butterfly valve (the so-called green valve) reduces turbulence and air entrapment in the overflow water, which reduces the extent of the turbidity plume released through the overflow duct. Finally, reduction of suspended solids is realized by changing the dredging approach (for example reducing dredging with the overflow), or by planning the timeframe during which dredging in specific areas is performed (for example by taking into account the tidal currents, the turbidity plume will not reach the sensitive area).
On specific projects (contaminated sediments, sheltered areas, limited water depth), silt screens are applied to confine the sediment plume.

JDN has built up extensive experience to reduce the suspended solids in the water column during dredging:

- JDN has performed turbidity measurements on 67 projects between 1995 and 2018 to verify the compliance of our works with permissible water quality and turbidity levels.
- In 18 of these cases, the measurements became available live and alarms were set for intervention and/or limit values in order to be able to do adaptive dredging management.

Examples:

(1) *Project:* Vale Malaysia is constructing a 90 million tonne per annum iron ore distribution center at Teluk Rubiah, located 300 km north of Kuala Lumpur, on the West coast of Peninsular Malaysia just south of the town and port of Lumut. The vessel that was mobilised was one of the largest hoppers in the fleet, the TSHD Leiv Eiriksson.

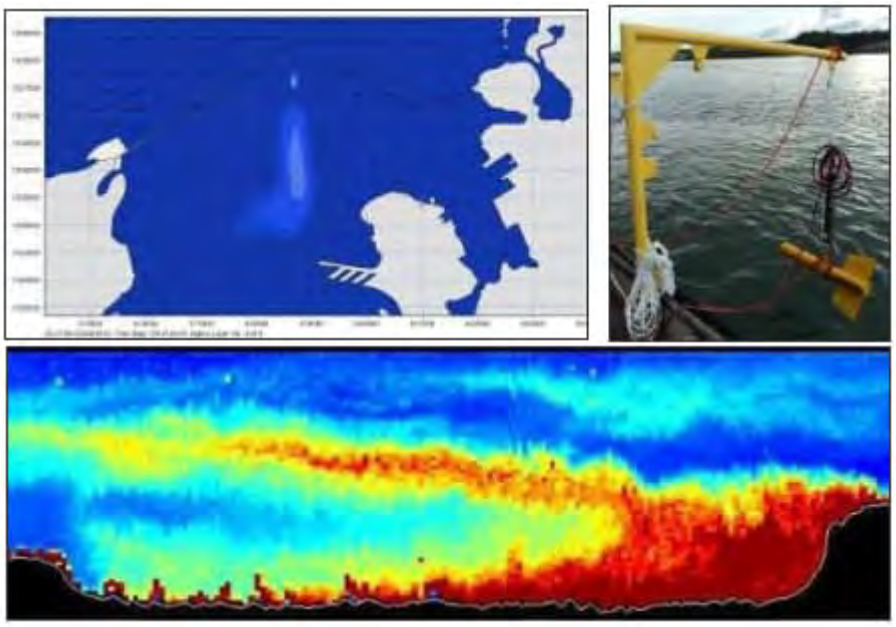
Managing the turbidity plume: on our project in Lumut Malaysia, an approach was developed based on a maximum spill budget (meaning that we had to ensure that no more than 7200 tons of fine sediment per day left the dredging area). The spill budget was based on tolerance limits and modelled total suspended solids (TSS) values at the height of sensitive areas (corals, aquaculture installations and fishing grounds). Important control measures included the very close cooperation and transparency between the environmental consultant and JDN, as well as the extensive measurement campaign. Measures taken to reduce the impact on the nearby sensitive areas included adjusting the overflow depending on the area being dredged and depending on the flow direction.

(2) *Project scope:* within the period from 1997 until 2000 per year an average of 9.4 million tons dry sediment was dredged to maintain the Belgian coastal ports and navigation routes. The deepening programme covering the approaches to the Westerschelde added to this quantity another 8.7 million tons dry sediment, spread over the period 1998 to 2000.

Environmental monitoring: Different stationary and mobile measuring techniques were adapted during different monitoring campaigns to determine the change of turbidity caused by different dredging techniques.

(3) *Project:* the Atlantic Dredging project is part of the expansion of the Panama Canal. This expansion plan entails the widening and deepening of the channel, as well as the construction of two new sets of locks.

Environmental restrictions: the contract specifications contained two major restrictions: only the northwest underwater disposal area was available and no overflow was allowed during dredging. The socio-Environmental Dpt. challenged these restrictions and based on a modelling study of the hydrodynamic conditions, sediment properties and transport processes, approval was received for the use of the northeast underwater disposal area. Based on a thorough modelling of dredging scenarios, the client allowed the use of the overflow for 20 min. This permission required an intensive daily monitoring of the sediment plume, for which a mobile system was set-up with real-time 2D plume visualization. Overflow dredging was finally stopped overall for this project, as the dredged material was not favourable and overflowing for 20 min did not result in higher productivity.



What is the relevance for Sandpiper?

During the Sandpiper project, the following techniques are available to reduce the size of the turbidity plume:

- Releasing overflow water through the overflow duct at the bottom of the ship, as opposed to releasing overflow water at the surface.
- The usage of the turbidity valve in combination with the usage of the overflow duct allows to realize an additional reduction of the turbidity plume.
- pump the overflow water through a pipeline under the thermocline, this is foreseen for deep-sea mining projects, but it has not been implemented up to now.

3.4 Settlement of suspended solids

Description of the process:
As described in paragraph §3.2, seabed disturbance is most important in the area of the dredging activities. Due to the turbidity plume, (fine) solids are spread beyond the immediate vicinity of the dredging activity. Eventually, sediment particles suspended in the water column settle on the seabed.

What is the impact?
Once the sediments are covering the seabed, these solids potentially cover corals, seagrass, bivalves or fish spawn areas and thus influencing the growth of the species.
The type/size of the solids and grains that is settling on the seabed is often different compared to the seabed composition, mainly because sediments in the turbidity plumes are often the finer fractions of the dredged material. These finer fractions are transported over larger distances, as the small particles take longer to settle. Accumulation of fine material may alter the habitat characteristics (see §3.2).

How is the impact monitored?
Monitoring the impact of settled fine solids is done by performing measurements in surrounding and sensitive areas, beyond the dredging location. During the dredging activities, samples of the overflow mixture are taken to determine the characteristics of the sediment in the turbidity plume. On different locations, the turbidity in the water column is measured to assess where settlement of the suspended solids is expected. Monitoring of the seabed, including seabed composition and ecological monitoring, surrounding the project area is done to compare baseline values with measurements over time.
The monitoring campaign is improved or extended with satellite images, and hydrodynamic modelling to show how the turbidity plume migrates in the water over time.

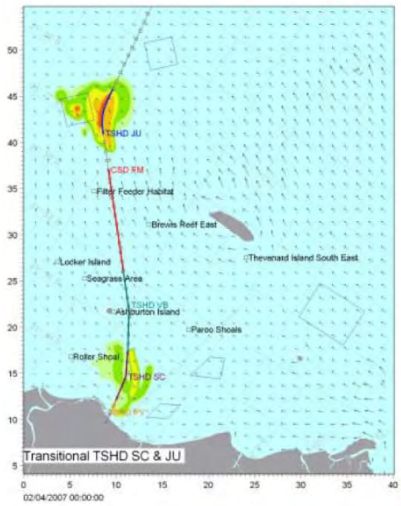
How does JDN reduce the impact?
The impact on the surrounding seabed of deposition of new material is reduced by adapting the dredging strategy whenever required, and by setting thresholds for turbidity values in the water column. In some cases, low mobile marine species are even relocated.

Examples:

(1) Project: The Cartagena bay is located just south of the city of Cartagena de Indias, on the Atlantic coast of Colombia. The project was divided in two parts, Bocachica and Manzanillo. Both located within the protected waters of the Cartagena Bay.
Environmental monitoring: Compared to average dredging projects the environmental requirements on the Cartagena bay project were extensive. Possible impacts of the dredging activities were mitigated by a flora and fauna management that included extensive ecological monitoring of coral and seagrass areas. The dredge zone was a sandy area with some dispersed rock

formations that were colonized with corals and sponges.
In general, information was gathered on benthic cover (in terms of composition and structure), together with abundance of commercially and ecologically important mobile invertebrates and the species richness and abundance of fish. Additionally black coral abundance, sponge abundance and species richness, and structural complexity of the substrate were measured. Subsequently, the low mobility species of commercial and ecological importance were relocated from within the dredge area to appropriate receptor sites. The organisms that were relocated included six species of corals, two sponge species, sea urchins, sea cucumbers, lobsters, conches and some fish of low mobility such as seahorses, scorpion fish, porcupine fish, and batfish.
The environmental monitoring included water quality and sediment monitoring, plankton community monitoring, air and noise monitoring and mangrove monitoring.

(2) *Project:* for the Wheatstone project, we excavated a 30 km long trench for an LNG pipeline. The pipeline is located in the Pilbara region of Australia where there are numerous coral reefs that form the basis of the marine ecosystem.
Managing the turbidity plume: in order to prevent the turbidity plume caused by the dredging activities from reaching the coral reefs, a detailed modeling study of the sea currents and turbidity plume was carried out in the tender phase and continuously adjusted and consulted during the project. The model predicted the trajectories of the turbidity plumes relative to the coral reefs and allowed dredging activities to be planned in such a way, in time and space, that the turbidity plume would not reach the coral reefs.



What is the relevance for Sandpiper?
The development of hydrodynamic model allows estimating the location, the characteristics and quantity of the settled material. For all species sensitive to settled solids, thresholds are determined and monitored.

3.5 Sound

Description of the process

Sounds are emitted by dredging equipment, and depending on the type of equipment the sound levels differ. Sounds from a trailing suction hopper dredger (TSHD), are similar to those of merchant ships. The dominant sound source is the main engine (500 Hz) and the propeller (300 Hz). Higher frequencies due to draghead/soil interaction, hydraulic transport, hopper loading, etc. have a higher frequency and are faster attenuated. The sounds can be both under water sounds and above water sounds.

What is the impact on the environment?

(1) Under water sounds can damage the hearing organs of marine mammals and fishes, occurring above 150 dB re 1µPa. Sounds from 100 dB re 1µPa trigger an avoidance response of marine mammals.
(2) Above water sounds may have a negative impact on resident species, residents and the tourist sector.

How is this monitored?

Before the start of the works, and during the dredging works sound measurements are performed. By collecting this data for numerous projects, a database is available of sound measurements for the JDN fleet.

How does JDN reduce the impact?

Different measures are taken depending on the location, distance and sensitivity of the recipient.

- A dedicated observation team onboard is permanently on the lookout for marine mammals. If any individual comes within a predefined range, operations are halted.
- For piling of wind turbine foundations, JDN has used bubble curtains to dampen the percussive sound when whales or other marine mammals are expected in the area.
- When working in close proximity of residential and touristic areas, above-water sound limits are imposed and sound barriers are installed.

Examples:

(1) *Project:* the project of the Port of Walvis Bay and the Port of Lüderitz (Namibia) covered maintenance dredging of the harbour basin and channel of the fishing harbour. For both sites, the dredging works were conducted by the splithopper suction dredger De Lapérouse.
Sound measurements: for both Walvis Bay and Lüderitz, the environmental monitoring included sound monitoring before and during the dredging works. Measurements values were overall within acceptable levels.

(2) *Project:* The 'Portier Cove offshore urban extension project' in Monaco (France) will create an area of six hectares, enabling the development of a new district, a new place to live in the Principality of Monaco.

Sound measurements: sound limits were imposed when working close to residential or touristic areas. In Monaco (2018), limits between 65 and 75 dB were imposed at the sensitive location, depending on the time of day. No measures were required for the dredgers, but for the rock installation vessels, sound absorbing panels were installed on deck.

What is the relevance for Sandpiper?
Emitted sounds of the THSD are similar to merchant ships and fishing ships that operate in the area. Sound emitted by a TSHD attenuates to <150dB beyond a distance of 100m from the ship, and therefore the impact is considered negligible.

3.6 Light

Description of the process:
Dredging is usually a continuous 24h operation, and the lights on deck that allow the crew to control the operation, can disturb marine life.

What is the impact on the environment?
The light pollution is a potential source of disturbance to marine life, for example due to the disturbance of the migration of birds or resident birds. Overall, the survival, reproduction, physiology, and movement of marine fishes, corals, birds, turtles, and other invertebrates are affected by artificial light at night.

How does JDN reduce the impact?
Mitigating measures are implemented as far as feasible and required. First, the light intensity can be reduced and the light can be directionally controlled to reduce the lighting towards specific areas, for example by making light attenuation barriers. Secondly, the dredging works can be planned in such a way that dredging is carried out outside specific periods (for example outside migration periods).

Examples:

(1) *Project:* for the Wheatstone project, we excavated a 30 km long trench for an LNG pipeline. The pipeline is located in the Pilbara region of Australia where there are numerous coral reefs that form the basis of the marine ecosystem.
Mitigating action with respect to light pollution: a part of the environmental team consists of Marine Fauna Observers (MFO), employed on board of the dredging vessels. The MFO has to make sure that during sailing and dredging activities, the vessel does not approach marine mammals and has to cease the operations in case this does happen. They complete environmental inspections on board and make sure the vessel operates without spilling deck light to the sea because this might distract marine life during night.

(2) *Project:* Jan De Nul Dredging Ltd. has been awarded by Qatar Gas Transport Co. Ltd. the Epic of Dredging and Breakwater Works (Phase 2A) for Erhama Bin Jaber Al Jalahma Shipyard – Port of Ras Laffan.

Mitigating action with respect to light pollution: several protected bird species were known to nest in and around the area of the work site. Especially the presence of the dwarf tern was of specific concern. The planning of the works was therefore adapted to limit interference with the nesting season. Regular bird observation inspections were performed. Inductions were given to the site personnel to allow recognition of the typical protected species and explain the procedure that needed to be followed. Appropriate light management was done on the site to prevent interferences with the birds.

What is the relevance for Sandpiper?
Appropriate light management is to be considered based on the identification of protected species (marine mammals and birds).

3.7 Emissions

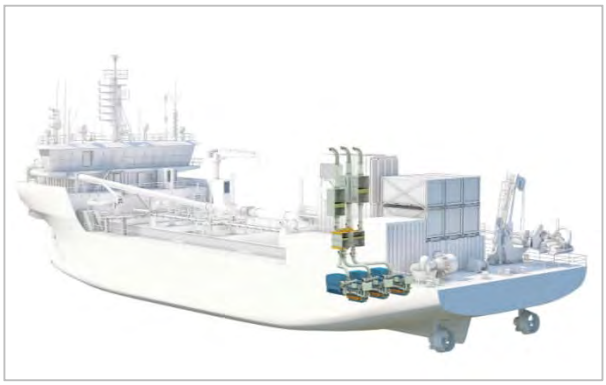
Description of the process:
The majority of dredging vessels are powered by fossil fuel, which leads to emissions of CO_2, SO_x, NO_x and black carbon. These emissions have a negative impact on the local environment and on global warming.

What is the impact on the environment?
Emission of CO_2 and other Greenhouse Gases cause global warming and climate change. Although the entire maritime fleet produces only 2% of global emissions, all sectors have to take responsibility and contribute to a sustainable world.

Emissions of SOx, NOx and black carbon locally reduce air quality. Air pollution is the largest contributor to pollution related deaths.

How does JDN reduce the impact?
Emissions from seagoing vessels are regulated by the International Convention for the Prevention of Pollution from Ships (MARPOL) and imposed to the member states of the International Maritime Organization, a UN Agency. JDN invests on a continuous basis in new vessels, and this includes the development of new clean technologies in line with regulations, which allow to reduce emissions.

Example:



(1) All vessels build after 2017 have the so-called ULeV system installed which combines selective catalytic reduction with a diesel particulate filter. This allows these vessels to limit NO_x and PM emissions within EURO5 standards (the standard for European road transport), which are more than 50% below MARPOL limits.

(2) JDN operates dredging vessels powered by biofuels on the beach reclamation projects at the Belgian coast (Knokke 2021, Ostend 2022) and on the maintenance dredging project of the Western Scheldt. "Alexander von Humboldt" has been operating exclusively on biofuel since November 2019, TSHD Kaishuu since June 2021.

3.8 Waste Management

Description of the problem:
Marine debris, also known as marine litter, is human-created waste that has deliberately or accidentally been released in a sea or ocean.

What is the impact?
Floating oceanic debris tends to accumulate at the center of gyres and on coastlines, frequently washing aground, where it is known as beach litter or tide wrack.

How does JDN reduce the impact?
Jan De Nul Group sets itself ambitious sustainability goals. Our Code Zero awareness programme brings together all our sustainable initiatives. With respect to waste management, JDN looks for circular solutions and ways to reduce our waste.

Furthermore, the waste management on board of our vessels is in accordance with the International Convention for the Prevention of Pollution from Ships (MARPOL). These regulations prescribe how our crew should collect, store, process and discharge waste on board a vessel.

Example from the Angola LNG project:
At the project level, waste streams had been established with separate handling of materials on the basis of their hazard classification, potential for re-use or recycling (wood, metal cans, glass

and scrap metal) and ultimate disposal point or treatment. All the waste generated during the project that could not be re-used or recycled by Contractor was segregated as per category and stored in dedicated containers on the site and/or vessels. Contractor had an incinerator plant installed on site for the incineration of the domestic non-hazardous waste produced in onshore and offshore activities.
During such long campaigns at sea, supply vessels are sometimes called upon to bring the waste ashore, if really necessary.

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[1] S. Aarninkhof, P. Laboyrie en M. Van Koningsveld, DREDGING FOR SUSTAINABLE INFRASTRUCTURE, CEDA / IADC, 2018.

[2] ICES, ICES Guidelines for the Management of Marine Sediment Extraction, ICES Cooperative Research Report No. 263: p.210–215, 2003.